EFFECT OF CHLORHEXIDINE SCURB ON SURGICAL SITE INFECTION A HOSPITAL BASED RANDOMISED STUDY

Dissertation submitted to

THE TAMILNADU DR.M.G.R. MEDICAL UNIVERSITY, CHENNAI

In partial fulfillment of the degree of

M.S. GENERAL SURGERY

Branch- I

PSG INSTITUTE OF MEDICAL SCIENCES AND RESEARCH, COIMBATORE

DEPARTMENT OF GENERAL SURGERY

APRIL 2016

CERTIFICATE

This is to certify that DR.S.KAMALRAJ postgraduate student (2014-2016) in the department of General Surgery, PSG INSTITUTE OF MEDICAL SCIENCES AND RESEARCH, Coimbatore has done this dissertation titled **"EFFECT OF CHLORHEXIDINE SCRUB ON SURGICAL SITE INFECTION"** under the direct guidance and supervision of guide Prof .DR.VIMAL KUMAR GOVINDAN and co-guide Prof .DR.APPALARAJU in partial fulfilment of the regulations laid down by the **Tamilnadu Dr.M.G.R. Medical university**, Chennai, for M.S., Branch – I General Surgery degree examination.

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DECLARATION

I, **Dr.S. KAMALRAJ.**, solemnly declare that this dissertation **"EFFECT OF CHLORHEXIDINE SCRUB ON SURGICAL SITE INFECTION-A HOSPITAL BASED RANDOMISED STUDY"** is a bonafide record of work done by me in the Department of General Surgery, PSG Institute of Medical Sciences and Research,Coimbatore, under the guidance of **Prof. DR. VIMAL KUMAR GOVINDAN, M.S, FRCS.**

This dissertation is submitted to the Tamilnadu Dr.M.G.R.Medical University, Chennai in partial fulfillment of the University regulations for the award of MS Degree (General Surgery) Branch-I, Examination to be held in April 2016.

Place: Coimbatore

Date:

Dr.S.KAMALRAJ

ACKNOWLEDGEMENT

I wish to thank PSG HOSPITALS for having permitted me to conduct this study in this hospital.

I am ever grateful to all the faculty members of Department of General Surgery and Microbiology, PSG IMS&R for their generous help, kind guidance, valuable advice, expert supervision & encouragement throughout my career & for the preparation for this dissertation.

Last but not the least, I express my gratitude to all the patients for their cooperation for being a part of my study, my colleagues and parents for their support and blessings, without whom nothing would have been possible in this world.

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September 10, 2014

To
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The Institutional Human Ethics Committee, PSG IMS & R, Coimbatore -4, has reviewed your proposal on 5th September, 2014 in its expedited review meeting held at IHEC Secretariat, PSG IMS&R, between 10.00 am and 11.00 am, and discussed your request to modify the title of your study entitled:

"Effect of Chlorhexidine scrub and supplemental peri operative oxygen on surgical site infection "

The following documents were received for review:

1. Amendment reporting form
2. Your letter dated 05.09.2014

After due consideration, the Committee has decided to grant approval to modify the title of your study as '***Effect of Chlorhexidine scrub on surgical site infection***'.

The members who attended the meeting held on at which your proposal was discussed, are listed below:

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Dr S Bhuvaneshwari	M.D	Clinical Pharmacologist Member - Secretary	Female	Yes	Yes
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INTRODUCTION

Surgical site infection is a dangerous condition and a heavy burden on the patient and social health system. It has been reported that surgical site infections are among the most common hospital acquired infections comprising 14 to 16% of all inpatient infections.

The incidence of infection varies not just from surgeon to surgeon, but also from hospital to hospital, from one surgical procedure to another, and most importantly from one patient to another. There are several factors contributing to the incidence.

Patient's skin is a major source of pathogens that cause Surgical Site Infection. A reduction of these pathogens can significantly reduce the incidence of surgical site infections.

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INTRODUCTION Surgical site infection

is a dangerous condition and **a heavy burden on the patient and social health system.** 52

Among hospital acquired infections it has been reported that due to surgical site infections are the main cause which is comprising around 14 to 16% of all inpatient infections.

Surgical site infection incidence **varies** not just **from** one **surgeon to** other **surgeon,** but also **from** one **hospital to** other **hospital, from one surgical procedure to** other, **and most importantly from one patient to another** 24

patient. There are several factors contributing to the incidence. Major source for Surgical Site Infection from the Patient is skin as it a main source for pathogens that cause. A reduction of these pathogens can significantly

reduce the incidence of surgical site infections. There **are** 13

many kinds of preoperative skin antiseptics are available for preparation. Povidone iodine and chlorhexidine are the commonly used antiseptics in clinical practice. The present study has been made an effort to evaluate

the efficacy of chlorhexidine alcohol over **povidone iodine in** elective **clean and clean contaminated surgeries. The** 53

major concern is about the increasing incidence of surgical site infections. Very few studies have been done in India to analyse the prevalence and risk factors of surgical site infections. Hence this study was also done to analyse the prevalence, risk factors and impact of organisms in surgical site infections at a tertiary care hospital. ABSTRACT

AIM To study **the effect of** chlorhexidine scrub **on surgical site infection,** 37

in comparison with povidone iodine.

OBJECTIVES: To assess **the effect of** Chlorhexidine scrub on **surgical site infection** 40

over Povidone- Iodine. (I) To assess the microbiological organisms found in surgical site infections. (II)

To assess the other **risk factors** contributing to the **surgical site infections.** 45

METHODOLOGY 300 patients who underwent elective surgeries from the department of general surgery, cardiothoracic surgery and pediatric surgery were prospectively studied. Detailed clinical history, pre and post operative evaluation were done for all patients. Patients were screened for any evidence of surgical site infection. The microbiological profile was analyzed in detail for infected cases. Patients were subjected into two groups. One group of patients underwent betadine scrub and the other group underwent chlorhexidine scrub pre operatively and were then compared using univariate analysis. In order to identify the risk factor for the presence of surgical site infection, analysis by logistic regression were done. Each patient was followed for a period of 30 days to assess the status of wound healing and any evidence of surgical site infection. The impact of surgical site infection was assessed by analyzing the associations of duration of hospital stay, any post operative complications, status of wound at the end of 30 days with any evidence of surgical site infection using appropriate statistical tools. The influence of other factors

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INTRODUCTION

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Surgical site infection is a dangerous condition and a heavy burden on the patient and social health system. Among hospital acquired infections it has been reported that due to surgical site infections are the main cause which is comprising around 14 to 16% of all inpatient infections.

Surgical site infection incidence varies not just from one surgeon to other surgeon, but also from one hospital to other hospital, from one surgical procedure to other, and most importantly from one patient to another patient. There are several factors contributing to the incidence.

Major source for Surgical Site Infection from the Patient is skin as it a main source for pathogens that cause. A reduction of these pathogens can significantly reduce the incidence of surgical site infections.

There are many kinds of preoperative skin antiseptics are available for preparation. Povidone iodine and chlorhexidine are the commonly used antiseptics in clinical practice. The present study has been made an effort to evaluate the efficacy of chlorhexidine alcohol over povidone iodine in elective clean and clean contaminated surgeries.

The major concern is about the increasing incidence of surgical site infections. Very few studies have been done in India to analyse the prevalence and risk factors of surgical site infections. Hence this study was also done to analyse the prevalence, risk factors and impact of organisms in surgical site infections at a tertiary care hospital.

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AIM

To study the effect of chlorhexidine scrub on surgical site infection, in comparison with povidone iodine.

OBJECTIVES:

To assess the effect of Chlorhexidine scrub on surgical site infection over Povidone-Iodine.

(I) To assess the microbiological organisms found in surgical site infections.

(II) To assess the other risk factors contributing to the surgical site infections.

METHODOLOGY

300 patients who underwent elective surgeries from the department of general surgery, cardiothoracic surgery and pediatric surgery were prospectively studied. Detailed clinical history, pre and post operative evaluation were done for all patients. Patients were screened for any evidence of surgical site infection. The microbiological profile was analyzed in detail for infected cases.

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The impact of surgical site infection was assessed by analyzing the associations of duration of hospital stay, any post operative complications, status of wound at the end of 30 days with any evidence of surgical site infection using appropriate statistical tools. The influence of other factors on surgical site infection were analysed by the same statistical tools.

RESULTS

Surgical site infections were isolated from 14 patients out of 300 (4.66%). 50% of isolated organisms (7 out of 14) were found in surgical site. The commonest organism isolated in one study was *Escherichia coli* followed by *Klebsiella and Staphylococcus spp.,* by univariate analysis. Patient's age, co morbid conditions, socio-economic status, length of hospital stay, ASA scoring,

duration of surgery, skin closure type, obesity, were associated with significance in those with MDRO infected foot ulcers.

Analysis by logistic regression indicated that about 3 factors significantly increased the risk of acquiring SSI infections.

1. Skin closure type= suture, staples
2. Duration of surgery
3. Length of post op stay

CONCLUSION

Effect of chlorhexidine scrub showed significant reduction in surgical site infection. Usage of chlorhexidine scrub as pre-operative skin preparation had significant reduction in surgical site infection when compared to the use of povidone iodine. Factors like type of cases (clean/clean contaminated), duration of surgery, length of hospital stay had significant impact in the development of surgical site infections.

REVIEW OF LITERATURE

REVIEW OF LITERATURE

Historical aspects

Man, from time immemorial has been tending to his wounds. The evolution of wound care evolved from witchcraft to potions and ointments. Hippocrates, the father of medicine, used vinegar and wine to treat wounds. Traditional Chinese medicine emphasised a holistic approach to wound healing, though none of it is relevant today.

In ancient India, Sushrutha had a more systematic approach to wound healing. Sushrutha Samahita had 2 chapters devoted to aspects of wound healing and the medicinal plants used to treat them.

Even as recent as a century ago, prevention and treatment of surgical site infections proved to be a major challenge for the surgeons. The world's first antibiotic, Penicillin, was discovered only in 1928. The surgeon did not have at hand the supportive treatments that are available now to treat infections. Not least

was the fact that there was a very poor understanding of the factors that led to wound infection.

There were a few major landmarks in the 19th century. Semmelweiss advocated hand washing, and use of antiseptic chlorinated lime solution. Joseph Lister identified that wound infection could be prevented by following the principles of antisepsis. Robert Koch recognized that microbial overgrowth led to infections.

Joseph Lister (Professor of Surgery, London, 1827-1912) and Louis Pasteur (French bacteriologist, 1822-1895) revolutionized the entire concept of wound infection. Lister was the first to recognize that antisepsis could prevent infection(1). The two world wars brought significant advancements in the understanding of surgical wounds.

In older days health care providers and the environment has been focused on asepsis as a part of infection control measures. Therefore they made an effort and evaluated both decolonization and decontamination patients

When a patients subjected in ICU AND develops Colonization of bacteria with MRSA he is known to increase the subsequent MRSA infection at higher incidence(2). There were, in addition, a few initiatives introduced to reduce the incidence of surgical site infection.

Routine sterilization of instruments began as a practice in the late 19th century, though Galen, way back in 150 AD had advocated boiling of surgical instruments prior to their use. Robert Koch and his team were the first to develop the steam sterilizer. Use of gloves was first introduced by Bloodgood, a student of Halsted. The role of wound debridement and delayed wound closure was put forth by Antoine Depage[3]

With the use of appropriate and prophylactic antibiotics, the management of wound infections had a new revolution. Eradication of the source of infection affecting the surgical wounds is still being continued. This is because of several factors such as the emergence of antibiotic-resistant bacterial strains and implant surgery. Further, the nature of more adventurous surgical interventions in immune compromised patients, has also been a factor.

Surgical site infection- Introduction

Surgical site infection (SSI) is a type of healthcare-associated infection in which a wound infection occurs after an invasive (surgical) procedure. SSIs have been shown to comprise up to 20% of all of healthcare-associated infections. An

SSI may range from a spontaneously limited wound discharge within 7–10 days of an operation to a life-threatening postoperative complication.

Most of surgical site infections are easily notified and preventable. To reduce the risk of developing surgical site infections the care must be taken in all the phases of operative period (pre-, intra- and postoperative phases). The quality of life is significantly affected in case of patient with Surgical site infections and also relatively associated with morbidity and extended postoperative hospital stay.

Murray et al[(4)] have shown that patients who have had SSI are twice as likely to develop incisional hernia. Patients who have had infections, have a lower survival rate as opposed to those who haven't[(5)].

Most considerable another factor in the surgical site infections which is a financial burden for both patients and as well as healthcare providers. There has been a recent study by Graf et al,[(6] which showed that surgical site infections resulted in the cost of treatment being three fold.

It may also be said that increasing numbers of infections are now being seen in primary care. This is because patients are allowed to go home earlier following day case and fast-track surgery.

The majority of SSIs become apparent within 30 days of an operative procedure and most often between the 5th and 10th postoperative days. However,

where a prosthetic implant is used, SSIs affecting the deeper tissues may occur several months after the operation.

Surgical Site Infection –Definition[7]

Surgical site infection (SSI) is a difficult term to define accurately because it has a wide spectrum of possible clinical features.The Centers for Disease Control and Prevention (CDC) have defined SSI to standardize data collection for the National Nosocomial Infections

Surveillance (NNIS) program [8,9]. SSIs are classified into Incisional SSIs, which can be superficial or deep, or organ/space SSIs, which affect the rest of the body other than the body wall layers.

Superficial Incisional Surgical Site Infection

This is an infection, which occurs within 30 days of the surgical procedure and only involves skin and subcutaneous tissue of the incision, and at least one of the following:

1.Purulent drainage with or without laboratory confirmation, from the superficial incision.

2.Organisms isolated from an aseptically obtained culture of fluid or tissue from the superficial incision.

3.At least one of the following signs or symptoms of infection: pain or tenderness, localised swelling, redness, or heat and superficial incision is deliberately opened by surgeon, unless incision is culture-negative.

4.Diagnosis of superficial incisional SSI made by a surgeon or attending physician.

Deep Incisional Surgical Site Infection

Infection occurring within 30 days of the surgical procedure, if no implant has been left in place or within one year if implant is used and the infection appears to be related to the operation. Further the infection involves deep soft tissue (e.g. fascia, muscle) of the incision and at least one of the following:

1.Purulent drainage from the deep incision but not from the organ/space component of the surgical site.

2.A deep incision spontaneously dehisces or is deliberately opened by a surgeon when the patient has at least one of the following signs or symptoms: fever (>38°C), localised pain or tenderness, unless incision is culture-negative.

3.An abscess or other evidence of infection involving the deep incision is found on direct examination, during reoperation, or by histopathologic or radiologic examination.

4.Diagnosis of deep incisional SSI made by a surgeon or attending physician.

Organ/Space Surgical Site Infection

Infection occurs within 30 days after the operation if no implant is left in place or within one year if implant is in place and the infection appears to be related to the operation and infection involves any part of the anatomy (e.g., organs and spaces) other than the incision which was opened or manipulated during an operation and at least one of the following:

1.Purulent drainage from a drain that is placed through a stab wound into the organ/space.

2.Organisms isolated from an aseptically obtained culture of fluid or tissue in the organ/space

3.An abscess or other evidence of infection involving the organ/space that is found on direct examination, during reoperation, or by histopathologic or radiologic examination.

4.Diagnosis of organ/space SSI made by a surgeon or attending physician.

Incidence:-

Surgical site infection rate is about one fifth of all healthcare associated infections. The incidence of SSI greatly varies worldwide and is also different from hospital to hospital. As per different studies, the rate of SSI ranges from 2.5% to 41.9% [(10)]. In a majority of the reviews, the incidence has not been reported to be under 5%, even in the most favourable conditions and when clean surgeries are performed[(11)].

Clean-contaminated surgeries have an SSI rate of 10%-16% and post-discharge SSI is around 2%[(11)]. During 1986-1996, the NNIS (National Nosocomial Infections Surveillance) SSI rate was reported to be 2.6% for all operations across different hospitals in the United States[(12)].

SSIs may take a few days to develop, and it may not become evident until after the patient has been discharged from hospital. The true rate of SSI is underestimated by surveillance, which has focused on detecting SSI during the

inpatient stay. This problem is exacerbated due to increasing trend towards day care surgery and shorter length of hospital stay postoperatively[13].

The value of surveillance is enhanced only by the systems that enable cases of SSI being identified even after discharging the patient from hospital. In community settings, there are a number of practical difficulties faced in identifying SSI reliably.

It is also important that valid comparisons of rates have to be made systematically and accurately in identifying the SSI[14].

Factors leading to wound infection:-

The risk of SSI is increased by certain factors.

- Factors that increase the risk of endogenous contamination (Procedures involving parts of the body with high concentration of normal flora such as the bowel)

- Factors that increase the risk of exogenous contamination (Prolonged operations which may increase the time length of tissues that are exposed)

- Factors that diminish the efficacy of the general immune response (example- diabetes, malnutrition, immunosuppression, radiotherapy, chemotherapy or steroids).

- There are also other local immune responses like foreign bodies (including implants and prosthesis), formation of a hematoma and damaged or devitalized tissue.

It is important to note that although infections may not manifest until after a few days, and sometimes even after discharge, there is a significant contribution from peri-operative factors.

After analyses, it has been stated that the factors which are significant in one type of surgery may not be applicable to all other surgical procedures. Certain risk factors have been listed below in detail.

Age:

In a prospective observational study, analysis of the data collected from 142 medical centres, identified age as an independent risk factor for SSI[15]. There was a significant increase in the risk of SSI with patients aged above 40 when compared with those under 40 years of age.

Underlying illness

The ASA (American Society of Anesthesiologists) classification of physical status score is being used in assessing the patients' preoperative physical condition. It provides a simple measure of severity of the underlying illness. Several studies have shown that a poor ASA score is associated with greater degree of developing of SSI[15,16].

The SSI incidence rate of 1.2% has been reported from a prospective cohort study for adult surgical patients from 11different hospitals[17]. A statistically significant higher incidence of SSI for those with an ASA score of 3 or more compared with those with an ASA score of 1 or 2 was reported. It has been found that a significant higher risk of SSI in patients with an ASA score of 3 or greater was due to associated severe systemic disease.

A number of studies in general surgery have shown that diabetes is strongly related with an increased risk of SSI[18-24]. Several studies, over the years, have shown that the associated diabetes has a strong increased risk of SSI, with as much as two to three fold. The reason may be related due to an altered cellular immune function. Associated vascular and neurological complications as well as an increased propensity for developing infections put these patients at a higher risk of developing SSI.

Malnourishment

Malnourishment has a significant increase in the incidence of SSI. One large prospective study of predominantly clean procedures on in children as well as adults, reported that the presence of malnourishment increases the incidence of SSI from 1.8% to 16.6% by univariate analysis.

A retrospective study on general surgical procedures, had shown a strong evidence associating the risk of SSI in patients with a low serum albumin[25]. Another study had shown that significant weight loss in the preceding 6 months and post-operative anaemia are also associated[26].

Obesity

The risk of SSI increases in a patient with a body mass index of 35 kg/m2 or more[25]. Obesity has an effect on tissue oxygenation and immune response functioning. This leads to poorly vascularised adipose tissue. In addition, operations performed on obese patients are also more complex and time consuming[27].

In a study on patients undergoing coronary bypass grafts, it was shown that pre-operative weight reduction significantly reduces SSI[28].

Intra-operative events

The three main intra-operative factors are hypotension, hypothermia and duration of surgery.

Intra-operative hypotension leads to tissue hypo perfusion. It could also be due to the fact that the more complex procedures are associated with this event.

Hypothermia, which is sometimes seen in major and complex procedures, has been associated with wound infection. Hypothermia leads to thermoregulatory vasoconstriction and therefore reduced tissue oxygenation. It also decreases the immune response[29].

The length of surgery has also been shown to be associated with SSI**.** In a study on laparoscopic colorectal surgery, it was found that procedures exceeding 4 hours were prone for wound infections[30].

Smoking

Studies had found that the smoking is associated with development of SSI[18,31]. Smoking cigarettes affects wound healing by the vasoconstrictive effects of nicotine and reduction in oxygen-carrying capacity of blood.

Reduced tissue oxygenation also leads to decreased deposition of tissue collagen and therefore poorer wound healing. It has been shown that there is a three fold increased risk of developing infections among smokers as opposed to non smokers.

Wound classification

For several years, it has been understood that there is a significant association of normally colonizing microbial flora at the operated site and subsequent development of SSI.

Three studies had found the association of wound classification with incidence of SSI[16]. The data from an infection surveillance in a large retrospective analysis showed the incidence of SSI rate per 100 operations for clean, clean-contaminated, contaminated and dirty wounds as 2.1, 3.3, 6.4 and 7.1, respectively[16].

Site and complexity of procedure

Complexity of the operation is also indicated as a risk factor for an SSI. A study on general and vascular surgery procedures, estimated a two- to three-fold increased risk of SSI with increasing surgical complexity[18].

Similarly different rates of SSI have been reported for the same procedure being performed at different sites of the body. For example, laminectomy done on the cervical spine is associated with a lower risk of SSI than laminectomy performed at other levels[32].

Type of skin closure

The two common methods of skin closure after a surgery are sutures and staples.

A large meta-analysis involving over 600 patients who have undergone orthopaedic procedures showed that there is a significantly higher infection rate when metallic staples are used for skin closure, as opposed to sutures[32].

Others

Radiotherapy and corticosteroids have also has been linked to an increased risk of SSI[33].

Measures to reduce wound infection:-

The risk of SSI is decreased when an intervention is taking place to reduce the skin microorganisms surrounding the incision.

Preoperative showering

Microbial flora in the skin consists of transient microorganisms which are acquired by touch that can be easily removed by washing with soap. The skin appendages such as hair follicles, have resident flora that normally live in skin.

These resident flora are not generally pathogenic but are not so easily removed by soap although usage of antiseptic may reduce their numbers.

There are millions of bacteria contaminating the skin, but the number required to produce a surgical site infection is low particularly in the setting of an implant.

One well-conducted systematic review examined the evidence for preoperative bathing or showering with antiseptics for the prevention of SSI[33].

Hair removal

The removal of hair is necessary to view the operative site adequately and to access the operative site. Sometimes it is removed because of a persistent increase in the risk of microbial contamination at the operative site.

During hair removal the micro-abrasions of the skin which are caused due to using razors for shaving may facilitate the multiplication of bacteria over the skin and skin surface. This will happen, particularly, when it is undertaken several hours prior to the procedure. This may subsequently lead to colonization of microorganisms in and around the skin, as a result of which, contamination of wound is facilitated and subsequent development of SSI[34].

Therefore, hair removal, if considered necessary, should be done by the least traumatizing method and minimizing the extent of damage to the skin. Further, the time interval between hair removal and surgery should be minimal.

It is therefore recommended that it be done on the day of surgery using the electric clippers with a single-use head. This will significantly reduce the development of SSI, as reported in this study[35].

Nasal decontamination

Staphylococcus aureus is found in the anterior nares. It is the main reservoir for this pathogen. It has been shown that these bacteriae multiply and migrate to the other skin surface area and the operated site.

Measures can be taken to clean the carriage of S.aureus, and if done prior to surgery, SSI can be reduced[36].

Mechanical bowel preparation

Bacterial flora that colonize the patient's skin, mucous membranes and gastrointestinal tract, and is the predisposing factor for the development of surgical site infection. In elective colorectal surgeries, prior to the surgery it has been

suggested removal of faecal matter from the rectum and colon confers an advantage[35]. Nowadays, mechanical bowel preparation for all intestinal surgery has become a fundamental component in many units.

There are many reasons where the mechanical bowel preparation has been considered to be advantageous which includes operative time, ability to palpate the bowel wall lesions, easy way of handling the bowel and the rate of stoma formation, all of which may have an indirect association with SSI.

However, there is no evidence that bowel preparation influences the incidence of SSI in patients undergoing colorectal surgery[35,37,38].

Preparation of skin

Since normal skin flora is also an aetiological agent of SSI, the patient's skin is a potential source. Preoperative skin disinfection, just prior to surgery, is effective in bringing down the microorganisms on the skin.

Cleanliness of the skin is the most important factor determining efficacy of antiseptic agents. Before applying the antiseptic agent, the superficial soil & debris present on the skin should be removed to reduce the risk of wound

contamination. Therefore, patients are advised to shower or have bath using soap either the night before or, preferably, on the day of surgery.

Hair removal, as part of skin preparation, as such, has many contradicting views on its role in surgical site infection. Studies have found that pre-operative shaving of the surgical site increases the risk of surgical site infection[39]. Therefore, hair should be left whenever possible. But, in case the presence of hair interferes with the surgical procedure then the following precautions should be taken.

- Hair removal- performed on the day of surgery (location should be outside the operating theatre or procedure room).
- Hair which interferes the surgical procedure should alone be removed.
- Hair should be removed using a single use electric or battery operated clipper.

The operative site should be free of all jewelry with preparation starting from the cleanest area to least clean area in a concentric fashion or from area of lower bacterial count to higher[40]. In case of procedure involving both abdomen and perineum, parts are prepared one after the other using separate depilator with abdomen preceding the perineum.

The solution should remain in contact for adequate timing and allowed to dry naturally instead of using swab or sponges. The prepared area should provide room for potential shifting of the drape, fenestration, new incisions or extension of the present incision and drain sites[39-42].

Hazard precautions:

The right volume of solution for an adequate contact period and drying time are essential to avoid skin irritation. Fire or burn injuries occur when there is pooling of the solution beneath or around the patient. The presence of excess hair can delay drying[41,43].

Product selection:

Selection of the product will depend on

- Patient's sensitivity or allergy
- The surgery site
- The condition of the patient
- The presence of organic matter
- Preference of surgeon

- Rates of SSI in the region
- The ability to significantly reduce micro-organisms with a broad spectrum of action.

The product should be non-irritating, non-toxic, rapidly acting with a persistent effect, and be compatible with other products for preparation.

There are several antiseptic solutions being currently used, but the common two are chlorhexidine and povidone iodine.

There are no randomized control studies comparing the efficacy of chlorhexidine with povidone iodine, and the last word on the superiority of one over the other is yet to be said[(44)].

CHLORHEXIDINE: METHOD OF ACTION, ADVANTAGES, SIDE EFFECTS

Chlorhexidine is a topical antiseptic solution. It has been used worldwide since 1954. It has provided an excellent result and record of safety and efficacy of applications in both children and as well as adults.

Commercially, chlorhexidine is available at a variety of concentrations ranging from 0.5%–4%. It is also available with different formulations, that is

with and without ethanol or isopropyl alcohol. Studies have shown that it is preferable to use 2% chlorhexidine with 70% alcohol.

It is diversely used as a preoperative skin preparation, hand washing, vaginal antisepsis, body washes to prevent neonatal sepsis and also as mouth washes for the treatment of gingivitis.

Method of action

Chlorhexidine gluconate, basically, is water-soluble and cationic biguanide in nature. It binds and acts in a bacterial cell which is negatively charged resulting in altered osmotic equilibrium in the cell.

Chlorhexidine affects membrane integrity at lower concentration, causing leakage of cellular contents and cell death. At higher concentrations cell death occurs due to precipitation of cytoplasmic contents[45,46]. The action is immediate.

It has a broad activity against gram-negative and gram-positive bacteria, facultative aerobes and anaerobes, some lipid enveloped viruses, yeasts and also HIV[47]. It reduces preoperative bacterial colonization, inhibits bacterial growth and decreases postoperative count. Chlorhexidine is not sporicidal.

The use of chlorhexidine has demonstrated the lower bacterial count and therefore less infection, in comparison with povidone iodine, in the following situations.

- Care of urinary catheter care (Munoz Price et al)[48]
- Surgical hand scrub (Lai et al)[49]
- Wound dressing (Eardly et al)[50]

Advantages

At the surgical site incision, chlorhexidine has been shown to have a superior effect in reducing the skin colonization when compared with povidone-iodine[(51)]. In addition, it has a residual activity on the skin that helps to prevent rapid re-growth of skin organisms and enhances the duration of skin antisepsis.

After a single application, chlorhexidine achieves greater reduction in skin flora. It also has longer residual activity than does povidone-iodine[(52,53)].

When surgeons used chlorhexidine hand scrubs, there was a greater reduction in the numbers of bacteria on the skin, compared with the use of other antiseptic agents. It was also seen that the bacterial count suppression was maintained up to 6 hours[(52,53)].

Chlorhexidine, unlike the iodophors, is active even in the presence of blood or serum proteins.

There is extensive data demonstrating the reduction in skin flora resulting from use of these products, but again, there is no clear comparison demonstrating superiority of either of these products in reducing SSIs[54].

Side effects

Chlorhexidine has a long-standing track record of being a safe and effective product with broad antiseptic activity and little evidence of emerging resistance of the microorganisms to it. For decades, chlorhexidine has been a well-tolerated, broadly used, skin and mucous membrane disinfectant.

The most frequent adverse reaction to chlorhexidine is contact dermatitis. but rare cases of hypersensitivity and anaphylaxis have been reported[55]. Contact of chlorhexidine with the inner ear may result in permanent hearing loss[56].

Strong solutions have been known to cause irritation of conjunctiva. Anaphylaxis has also been reported.

POVIDONE - IODINE: METHOD OF ACTION, ADVANTAGES, SIDE EFFECTS

Povidone iodine the most widely used Iodophor which is a stable chemical complex of elemental iodine and polyvinylpyrrolidone.[57]

It is a valuable antiseptic which has been recognized for more than a century. It has been traditionally used as a preoperative antiseptic by surgeons. Povidone-iodine is a broad spectrum antiseptic which is used for topical application in the treatment and also prevention of infection in wounds.

Method of action

Iodine is an effective broad-spectrum bactericide and effective against viruses, fungi, yeasts, molds, and protozoans. It is a broad spectrum microbicidal that helps in destroying microbial protein and DNA. It oxidizes cell constituents, iodinates proteins and inactivates them.

The chemistry of povidone-iodine is complex and not well understood. Therefore, the phenomenon of increased bactericidal activity with dilution is difficult to explain. One hypothesis is that the concentration of "free" iodine (i.e., the elemental iodine in solution) significantly contributes to the bactericidal activity of povidone iodine solution[58].

The high degree of bactericidal efficiency with respect to highly resistant gram-positive pathogenic micro-organisms, such as methicillin-resistant *Staphylococcus aureus* (MRSA) and*Enterococcus* strains, has made the agent particularly useful and significant for hospital hygiene. Cheaper than topical antibiotics, it is recognized as a staple solution for preparing the eye for surgery.

Evidence has also recently indicated the antiviral activity of povidone-iodine against viruses like herpes simplex and adenoviruses and enteroviruses, as well as reaffirmed its high degree of efficiency against *Chlamydia.*

Advantages

It has many potential advantages including broader antibacterial spectrum, lack of identifiable bacterial resistances and significantly lower price.

The microbicidal action spectrum of povidone iodine (PI) is broad, even after short exposure times.

These preparations have widespread popularity today, attributable to their absence of odor, staining and lack of skin irritation. However, recent confirmation of intrinsic contamination of a 10% povidone-iodine solution with Pseudomonas cepacia startled many microbiologists and chemists considered experts in the antiseptic and disinfectant field[59,60].

Unlike local antibiotics and other antiseptic substances, no resistance seems to develop. Recently povidone-iodine has been found application in the field of nanomaterials.

Disadvantages

The side effects include

- Severe pain on application
- Irritation
- Pruritic

- Erythema and sometimes oedematous erythema
- Acneform eruption.

Apart from a moderate action, it has a disadvantage of a delayed drying time. The optimal time is approximately 3 minutes. Quite often the practice is to quickly dry with a sterile towel, in order to start the surgery, thus compromising on its efficacy[61].

Further, it has been noted povidone iodine sometimes leaves a stain, that is difficult to remove. Attempts to remove will result in further skin irritation.

CHORHEXIDINE vs POVIDONE IODINE

Povidone-Iodine is not considered today the most efficient disinfectant of the surgical field in the prevention of Surgical Site Infections and the major infection risk is reported to drop to 9% with Chlorhexidine in case of a 16%with Povidone-Iodine disinfection[75,76].

Chlorhexidine has been demonstrated to be superior to Povidone-Iodine solution for reducing colony formed units(CFU). There was evidence from one study suggesting that pre-operative skin preparations with Chlorhexidine in

methylated spirits let to a reduced risk of surgical site infections compared with an alcohol based Povidone Iodine solution[78].

No of studies have been conducted United states and as well as in India and reported as Chlorhexidine is better antisepsis for pre-operative skin preparation than the Povidone-Iodine preparation.

In conclusion the simplicity of use and liking of Povidone-Iodine are good, made exception for the long drying time that sometimes pushes the surgeon to use a paper towel to absorb the residual fluid ,and shorten the required time of action. Sometimes resulting change of glove due to contamination.

The alternative product Chlorhexidine has many advantages and eliminates part of these drawbacks. Its action is faster and its activity persists independently from the contamination by body fluids, it presents a residual effect. It does not require auxiliary material for the application and drying. It does not drip off the surgical field and it does not make a mess and allows a better sticking og the surgical drapes for bordering of the field.

METHODOLOGY

METHODOLOGY

This study is a randomized control study conducted to find the effect of chlorhexidine scrub on surgical site infection over Povidone- Iodine.

The present study was conducted on patients admitted for surgery in various departments like General Surgery, Paediatric Surgery, and Cardiothoracic &Vascular Surgery units of PSG Institute of Medical Science and Research Centre.

A total number of 300 clean and clean contaminated elective surgeries in various departments (as mentioned above) from September 2014 to May 2015 were included in the study. Written informed consents were obtained from the patients. The patients were assessed pre-operatively, intra-operatively and post-operatively. Detail clinical history of the patient and other relevant data were collected using structured case report forms.

For each of the patients, the following details were entered: age, sex, BMI, socio-economic status, diagnosis, surgery done, any co-morbid conditions, personal habits, nutritional status, haemoglobin level, type anesthesia, type of surgery by CDC definition, duration of the surgery, prophylactic antibiotic usage, pre-operative skin preparation, pre-operative scrub used – Chlorhexidine/ Povidone Iodine, wound closure, length of pre-op and post-operative stay was assessed. Each patient was followed up from the time of admission till discharge from the hospital and also for 30 days post-operatively.

After assessing preoperatively, patients were subjected into two groups B & C group respectively by randomization. The B group patients were subjected to povidone iodine scrub pre-operative surgical site painting, whereas the C group patients were subjected to chlorhexidine scrub.

Post operatively patients were monitored for the development or any evidence of surgical site infection. Surgical wound was inspected at the first time of dressing, at the time of discharge and weekly thereafter for 30 days. Wound infection was diagnosed, if any one of the following criteria were fulfilled; serous or non-purulent discharge from the wound with signs of inflammation (edema, redness, warmth, fever, tenderness, induration, localized warmth), wound gape, wound dehiscence, other wound complications like haematoma, bleeding.

Wound swabs were obtained from the floor of surgical site. Direct microscopic examination and aerobic cultures were done by standard methods. The bacteriological spectrum and the sensitive antibiotics were noted for each patient after which antibiotics was given accordingly. Management of wound infection is also assessed in detail with patient outcome.

For analyzing the factors influencing the surgical site infection, the patients were grouped into clean and clean contaminated cases. The data was collected and entered in the SPSS data sheet. The data was analyzed using SPSS 20 for descriptive statistics.

The test variables were compared using chi-square test for qualitative variables and student's test for quantitative variables. The variables for which the association was statistically significant ($p<0.1$) were introduced in a logistic model to explain the presence of SSI.

The impact of SSI was assessed by analyzing the mean duration of hospital stay and outcome of the patient, using the above said statistical tools.

METHODOLOGY	
AIM	• To study the effect of chlorhexidine scrub on surgical site infection • To analyze the other factors influencing surgical infection • To analyze the microbiological organisms in surgical site infection
STUDY DESIGN	A prospective hospital based observational study
STUDY POPULATION	Selective patients from general surgery, cardiothoracic surgery, peadiateric surgery over a period (Sep2014-May2015) were included in the study
SAMPLE SIZE	300
INCLUSION CRITERIA	Elective open surgery

METHODOLOGY	
EXCLUSION CRITERIA	➢ Emergency/laparoscopy surgery ➢ Allergic to chlorhexidine ➢ Immuno compromised patients ➢ Those who do not consent
DURATION OF STUDY	9months
STUDY PERIOD	Sep2014-May2015

PROFORMA

Bar code

Study No:

Name :

Age:

Sex:

Dept /Unit :

IP No :

OP No :

Date of admission:

Date of discharge :

Weight in kgs-:

Ht :

BMI :

Occupation :

SES :

Diagnosis:

Any Co morbid conditions *(Hypertension /Diabetes Mellitus/ Immunosuppression/ etc)***– Yes / No**

- If **Yes**,mention the condition and whether controlled**…….**

Personal Habits – Smoking / Alcohol

Nutritional status :

Haemoglobin :

Type of Anaesthesia& ASA Score :

Prophylactic Antibiotic given– Yes / No

If **Yes,** name of the antibiotic and when given

Skin preparation:

Preoperative scrub used – Chlorhexidine or Povidone-iodine

Type of surgery: Clean / Clean Contaminated

Duration of surgery in hours:

OT No:

Wound closure: Staples / Suture / Steristrips / Other

Did the patient develop SSI- Yes/No–

- **If Yes –**
  - When did the infection develop -
  - Describe the infection –
    - Erythema
    - Wound gape
    - Wound dehiscence
    - Discharge
  - Culture sensitivity report –

Other wound complications : Haemotoma / Bleeding / Other

Length of postoperative hospital stay:

Management of infection (if any) details :

Patient Out come :

RESULTS

RESULTS

300 patients undergoing elective surgeries, 100 each from the departments of CTVS, Paediatric Surgery & General Surgery, were included in this study, after obtaining their consent. 36.3% of the patients were 50 years or older with the average age being 58.3 years. 70.7% of the patients were males, showing a distinct male preponderance. Most (49.3%) belonged to class III socio-economic status followed by class II (30.0) as per Modified Prasad's Classification (Table 1)

Table 1: (Demographic details)

Variable	Number	Percentage
AGE DISTRIBUTION		
<10Yrs	92	30.7
10-30Yrs	17	5.7
30-50Yrs	82	27.3
>50Yrs	109	36.3
SEX DISTRIBUTION		
Male	212	70.7
Female	88	29.3
SOCI-ECONOMIC STATUS		
Class I	27	9.0
Class II	90	30.0
Class III	148	49.3
Class IV	35	11.7
Class V	0	0

The two groups (povidone iodine and chlorhexidine) are more or less evenly matched, as shown in the following table

Table 2: Demographic details of the two groups

Variable	**Povidone Iodine**	**Chlor-hexidine**	**Total**
AGE DISTRIBUTION			
<10Yrs	47 (51.1%)	47 (51%)	92
10-30Yrs	11 (64.7%)	6 (34.3%)	17
30-50Yrs	39 (47.6%)	43 (52.4%)	82
>50Yrs	53 (48.6%)	56 (51.4%)	109
SEX DISTRIBUTION			
Male	101 (47.6%)	111 (52.4%)	212
Female	49 (55.7%)	39 (44.3%)	88
SOCIO-ECONOMIC STATUS			
Class I	9 (33.3%)	18 (66.7%)	27
Class II	49 (54.4%)	41 (45.6%)	90
Class III	76 (51.4%)	72 (48.6%)	148
Class IV	16 (45.7%)	19 (54.3%)	35
Class V	0	0	0

Co-morbid conditions like Systemic Hypertension, Type II Diabetes Mellitus, & other medical conditions were found in 34.7% of patients. A majority of the patients (78.7%) were neither smokers nor consumers of alcohol.

Table 3 Co-morbid Conditions & Personal Habits

Variable	**Number**	**%**
Co-morbid conditions present Absent	104 196	34.7 65.3
Alcohol and/or smoking history Nil	64 236	21.3 78.7

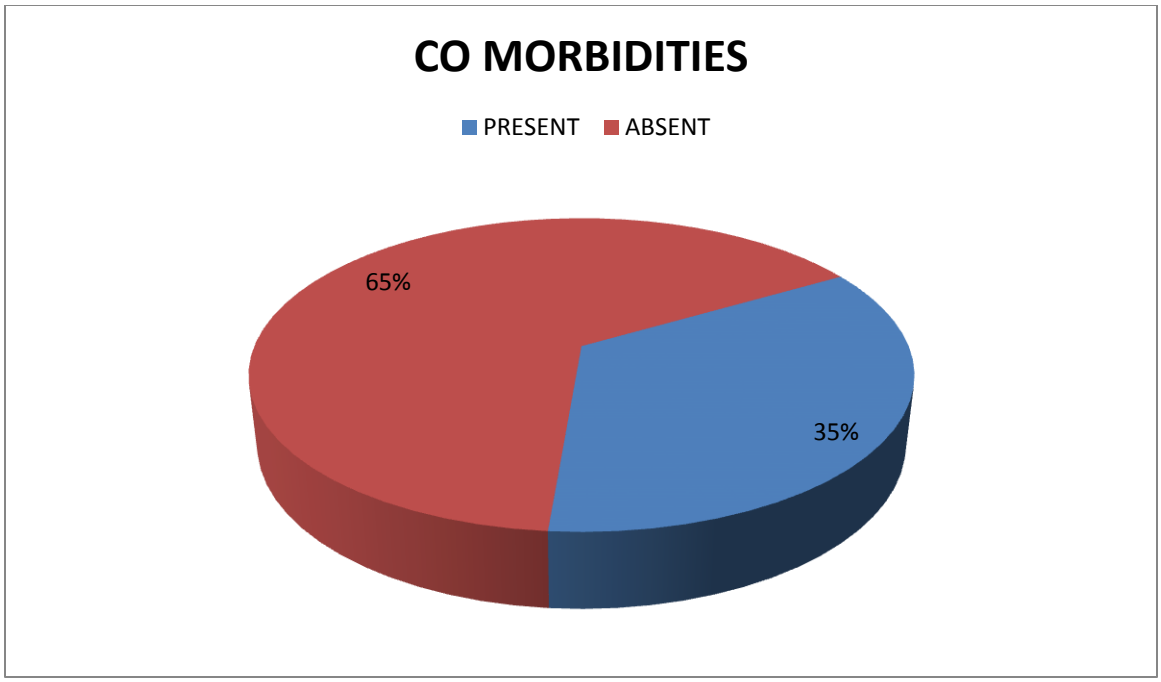
The following table will show that the two groups (povidone iodine and chlorhexidine) are more or less evenly matched (Tables 4).

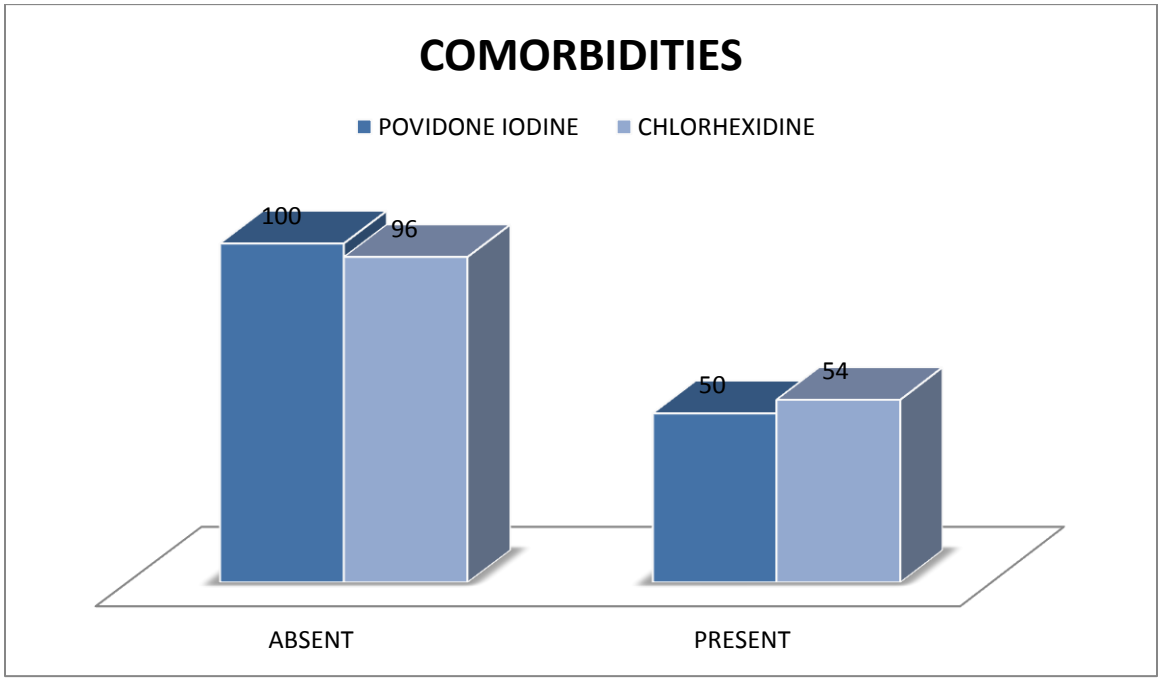
Table 4

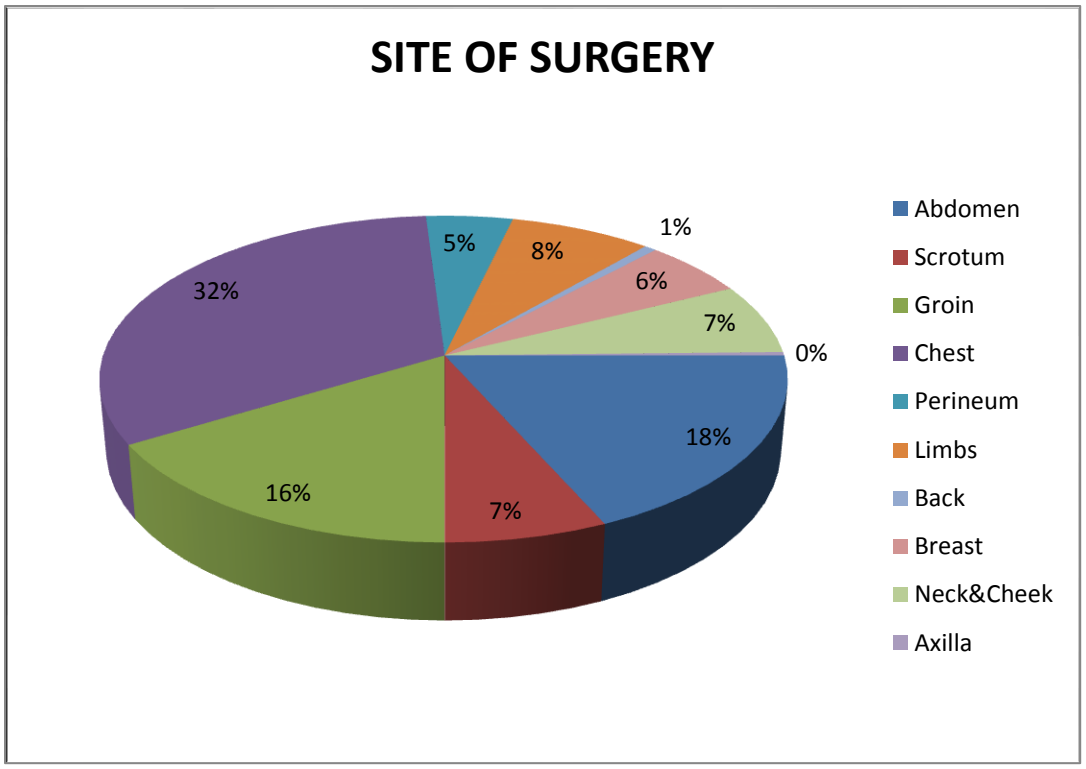
Variable	Povidone Iodine	Chlor-hexidine
Co-morbid conditions Absent Present	100 (51.0%) 50 (48.1%)	96 (49.0%) 54 (51.9%)
Alcohol and/or smoking history Nil	26 (40.6%) 124 (52.5%)	38 (59.4%) 112 (47.5%)

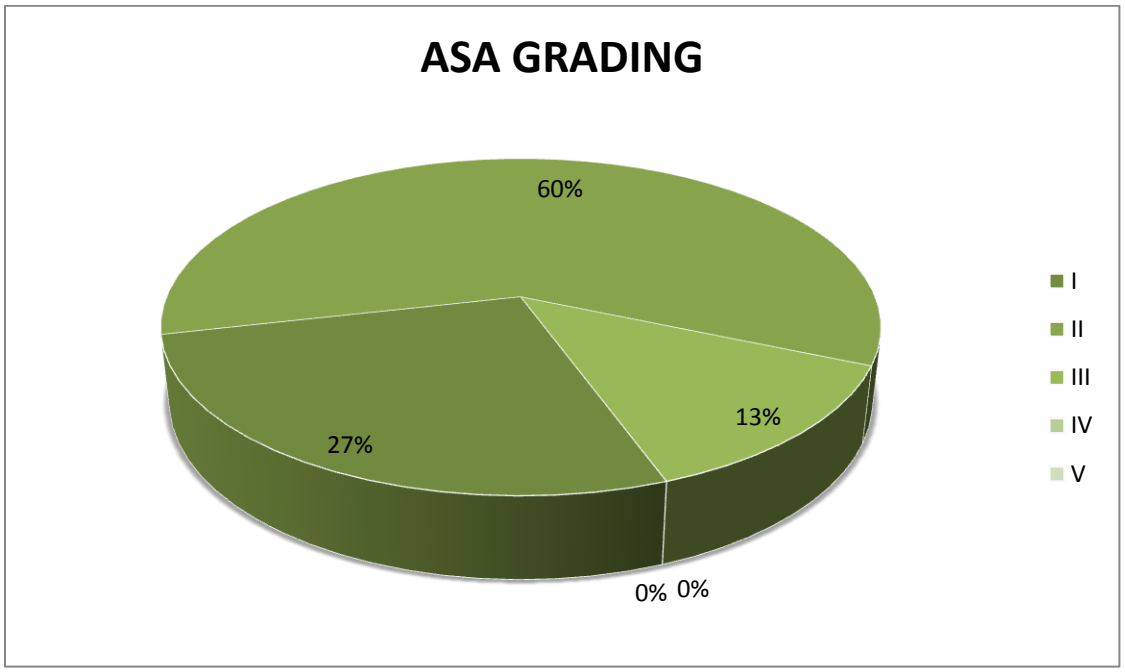
Table 5: Site of surgery & ASA grading

Variable	Number	Percentage
Site of surgery		
Abdomen	55	18.3
Scrotum	20	6.7
Groin	49	16.3
Chest	98	32.7
Perineum	14	4.7
Limbs	23	7.7
Back	2	0.7
Breast	17	5.7
Neck & Cheek	21	7.0
Axilla	1	0.3
ASA Grading		
I	81	27.0
II	180	60.0
III	39	13.0
IV	0	0
V	0	0


CO MORBIDITIES
PRESENT
ABSENT
65%
35%


COMORBIDITIES
POVIDONE IODINE
CHLORHEXIDINE
100
96
50
54
ABSENT
PRESENT

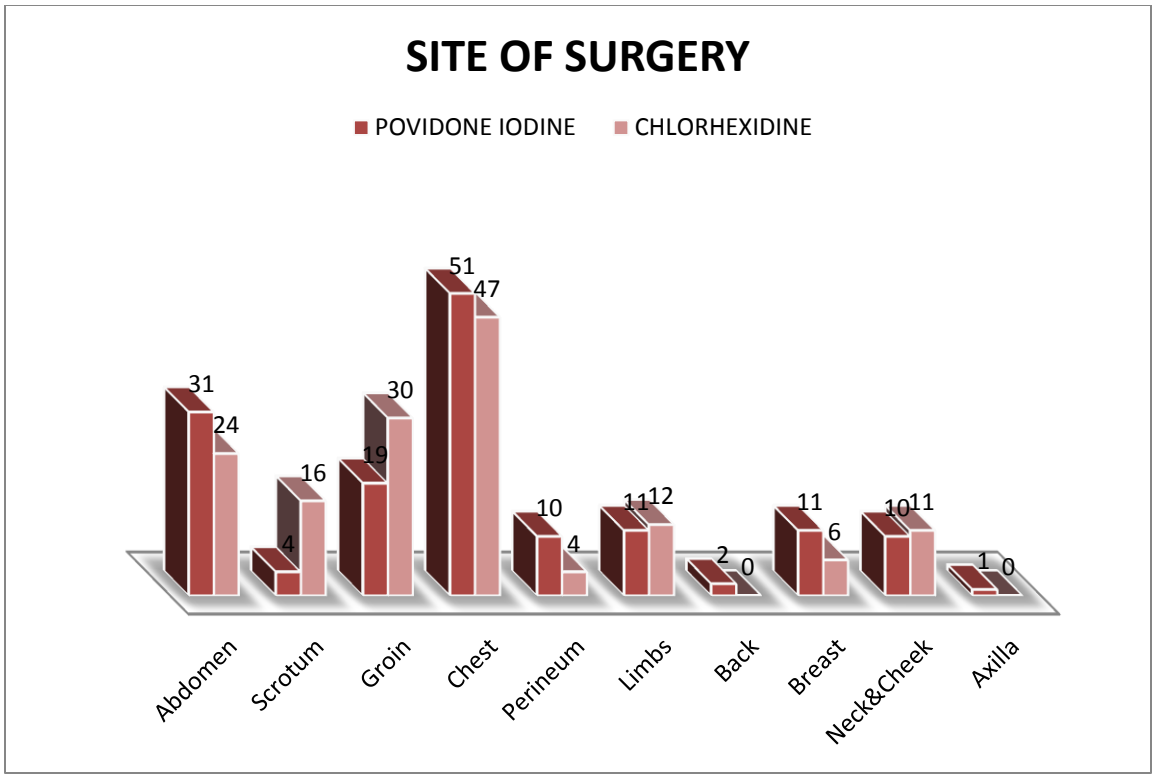

SITE OF SURGERY
5%
8%
1%
6%
7%
0%
18%
7%
16%
32%
Abdomen
Scrotum
Groin
Chest
Perineum
Limbs
Back
Breast
Neck&Cheek
Axilla

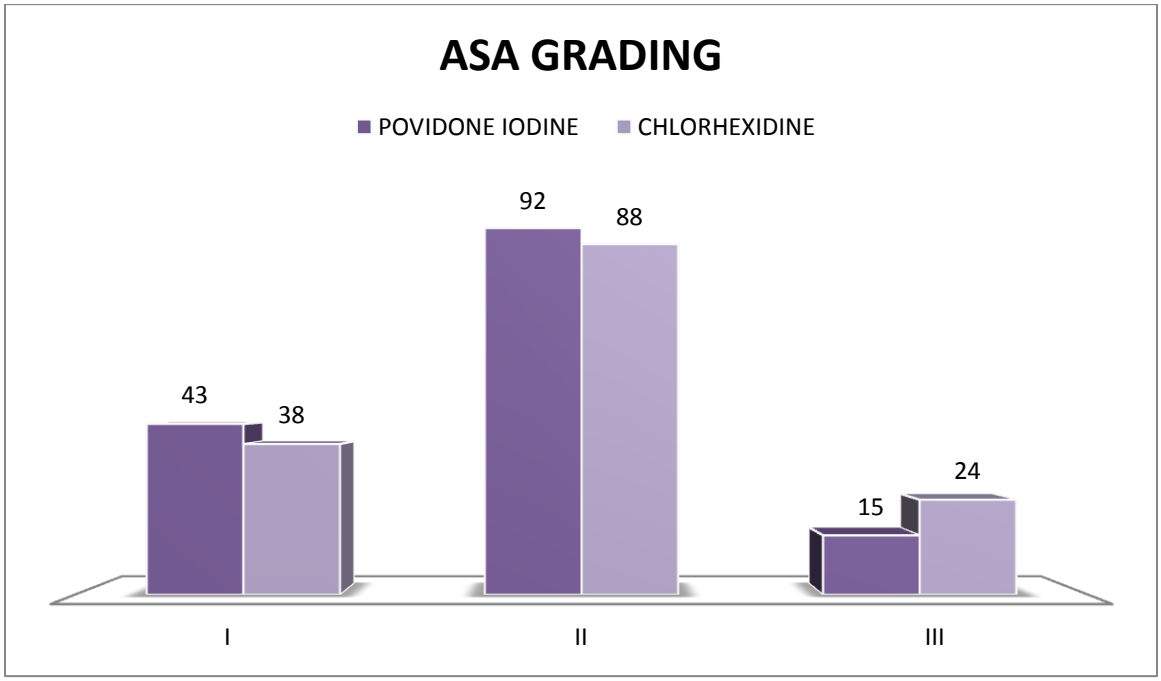

ASA GRADING
60%
13%
27%
0%
0%
I
II
III
IV
V

The commonest site of surgery in this study, as seen in the table above (Table 5) was the chest (32.7%) followed by abdomen (18.3%). The least common site was axilla (0.3%). As per the ASA (American Association of Anaesthesiology) grading system, most of the patients were found to fall under grade II (60.0%) who are liable to have mild systemic disease. The following table will show that the two groups (povidone iodine and chlorhexidine) are more or less evenly matched (Table 6).

Table 6:

Variable	Number		
SITE OF SURGERY	**Povidone Iodine**	**Chlor-hexidine**	**P value**
Abdomen	31 (56.4%)	24 (43.6%)	
Scrotum	4 (20.0%)	16 (80.0%)	
Groin	19 (38.8%)	30 (61.2%)	
Chest	51 (52.0%)	47 (48.0%)	
Perineum	10 (71.4%)	4 (28.6%)	.037
Limbs	11 (47.8%)	12 (52.2%)	
Back	2 (100.0%)	0 (0%)	
Breast	11 (64.7%)	6 (35.3%)	
Neck&Cheek	10 (47.6%)	11 (53.4%)	
Axilla	1 (100.0%)	0 (0%)	
ASA Grading			
I	43 (53.1%)	38 (46.9%)	
II	92 (51.1%)	88 (48.9%)	
III	15 (38.5%)	24 (61.5%)	


SITE OF SURGERY
POVIDONE IODINE
CHLORHEXIDINE
31
24
4
16
19
30
51
47
10
4
11
12
2
0
11
6
10
11
1
0
Abdomen
Scrotum
Groin
Chest
Perineum
Limbs
Back
Breast
Neck&Cheek
Axilla


ASA GRADING
POVIDONE IODINE
CHLORHEXIDINE
43
38
92
88
15
24
I
II
III

A majority of the cases were clean cases (81%) and the rest clean contaminated. Most of the patients (73.3%) had duration of surgery lasting between 1 to 5 hours, as seen in Table 7.

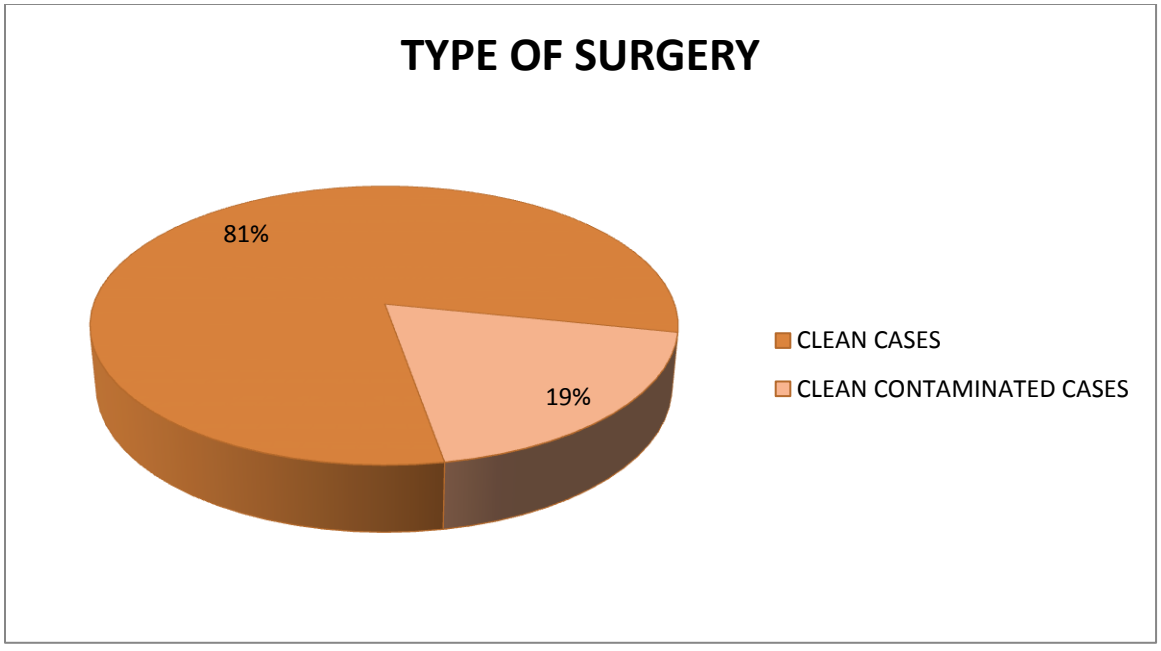
Table:7

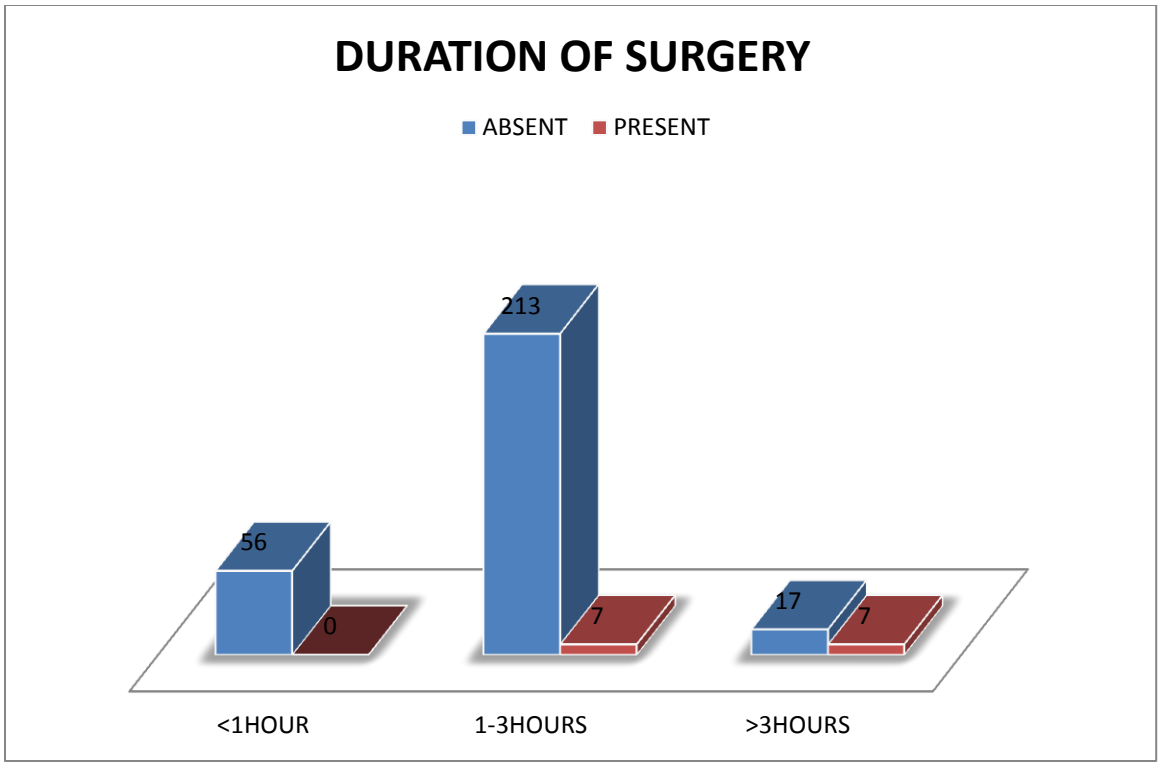
Variable	**Number**	**Percentage**
TYPE OF SURGERY		
Clean cases	243	81.0
Clean contaminated cases	57	19.0
DURATION OF SURGERY		
<1hour	56	18.7
1-3 hrs	220	73.3
>3hrs	24	8.0

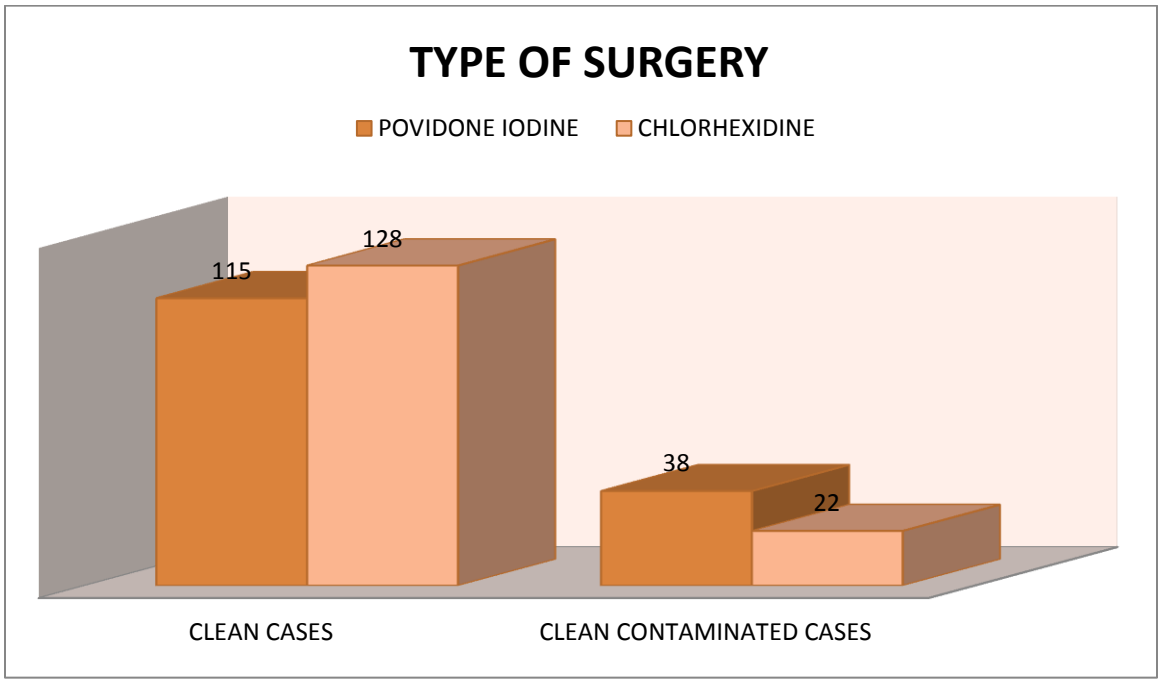
Table 8 shows that the two groups (povidone iodine and chlorhexidine) are more or less evenly matched.

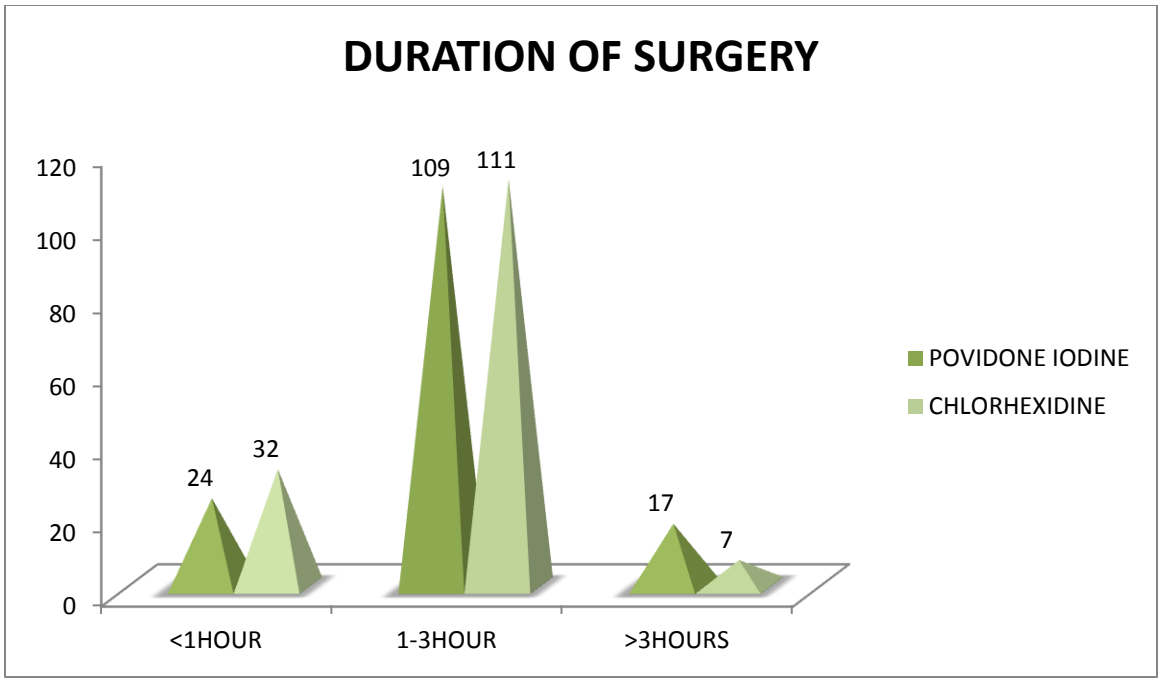
Table:8

Variable	Number		P value
TYPE OF SURGERY	**POVIDONE-IODINE**	**CHLOR-HEXIDINE**	
Clean cases	115 (47.3%)	128 (52.7%)	.103
Clean contaminated cases	35 (61.4%)	22 (38.6%)	
DURATION OF SURGERY			
<1hour	24 (42.9%)	32 (57.1%)	<0.05
1-3 hrs	109 (49.5%)	111 (50.5%)	
>3hrs	17 (70.8%)	7 (29.2%)	




DURATION OF SURGERY
ABSENT
PRESENT
56
0
213
7
17
7
<1HOUR
1-3HOURS
>3HOURS


TYPE OF SURGERY
POVIDONE IODINE
CHLORHEXIDINE
115
128
38
22
CLEAN CASES
CLEAN CONTAMINATED CASES



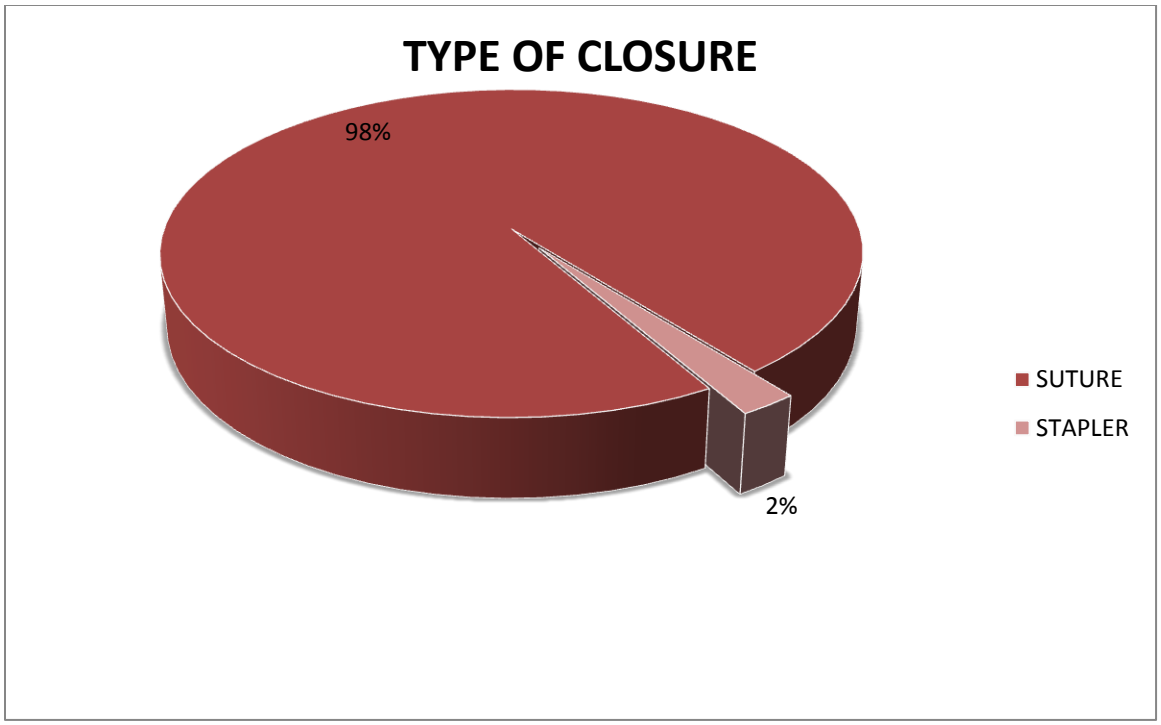
With regard to type of wound closure, 97.7% of patients had the closure done by suturing. The history of length of post-operative stay revealed that 42.3% of cases taken for study had only 5 days of hospitalization and almost an equal number between 5 and 10 days. 15.7% had an extended post-operative stay of 10 or more days (Table 9).

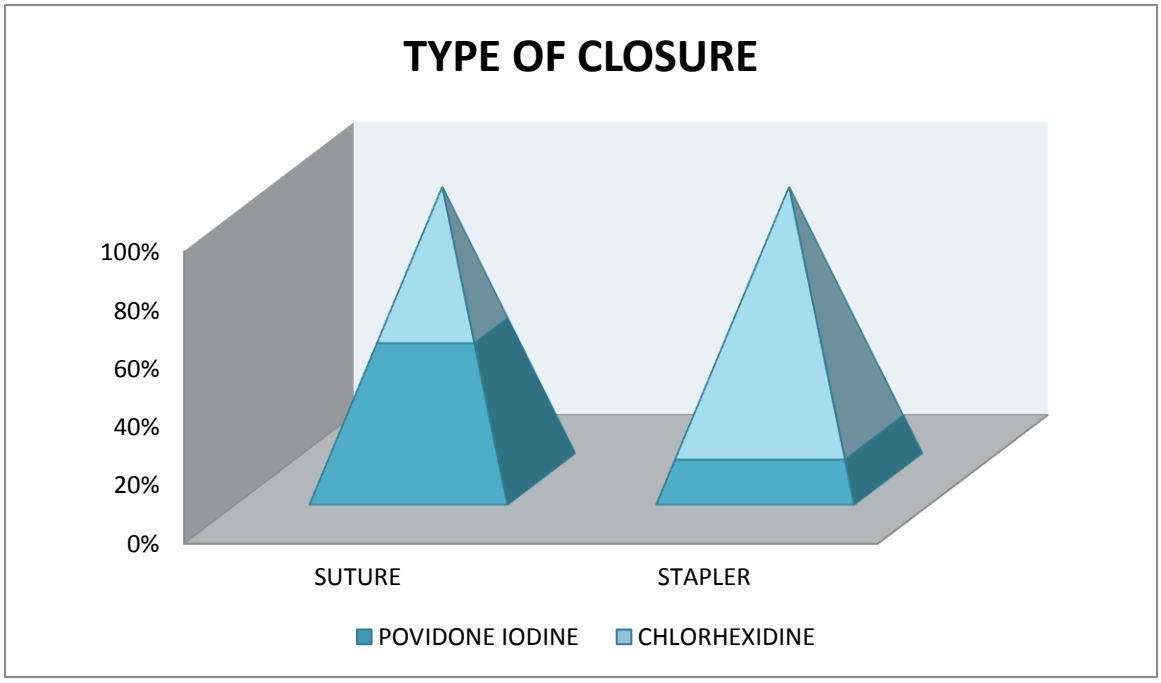
Table 9

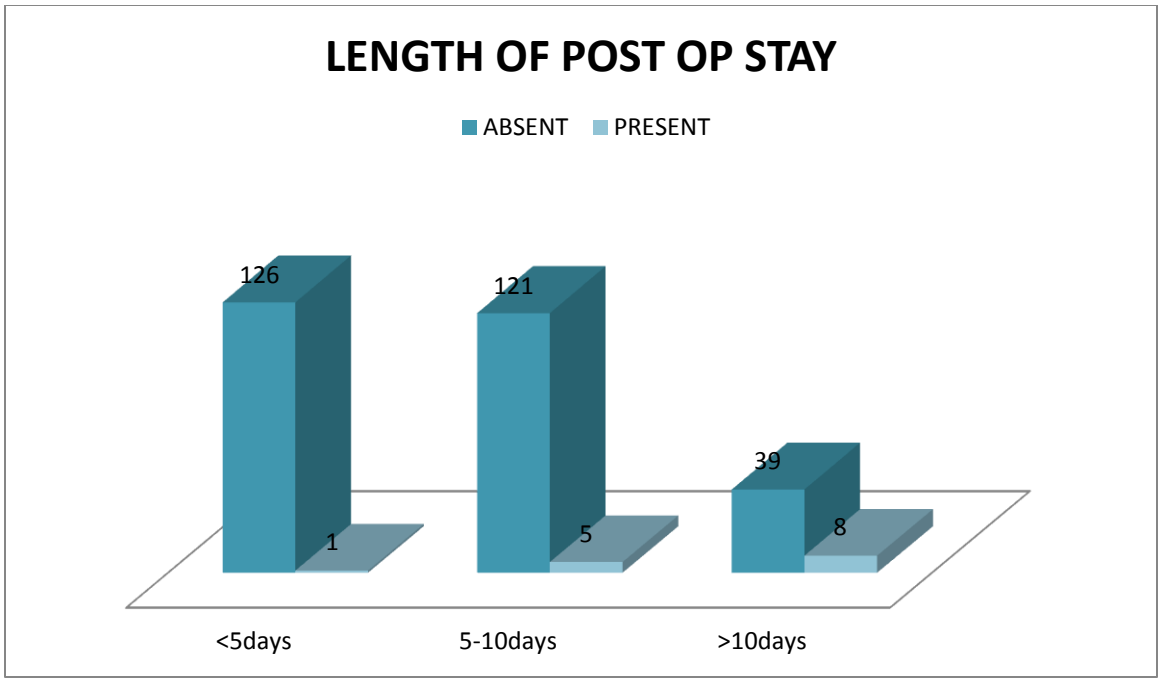
Variable	Number	%
TYPE OF CLOSURE		
Sutures	293	97.7
Staplers	7	2.3
POST OPERATIVE STAY		
<5days	127	42.3
5-10days	126	42.0
>10days	47	15.7

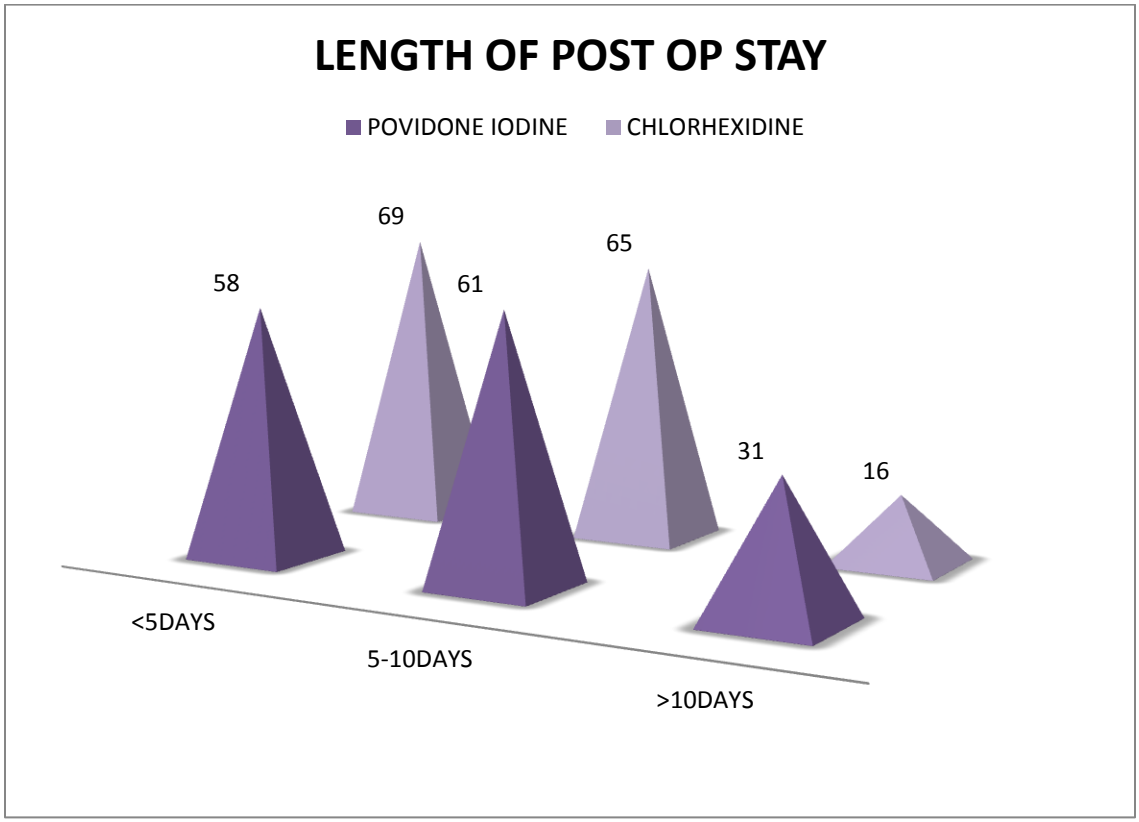
Table 10

Variable	Number	
TYPE OF CLOSURE	**POVIDONE-IODINE**	**CHLOR-HEXIDINE**
Sutures	149 (50.9%)	144 (49.1%)
Staplers	1 (49.1%)	6 (85.7%)
POST OPERATIVE STAY		
<5days	58 (45.7%)	69 (54.3%)
5-10days	61 (48.4%)	65 (51.6%)
>10days	31 (66.0%)	16 (34.0%)


TYPE OF CLOSURE
98%
2%
SUTURE
STAPLER


TYPE OF CLOSURE
100%
80%
60%
40%
20%
0%
SUTURE
STAPLER
POVIDONE IODINE
CHLORHEXIDINE


LENGTH OF POST OP STAY
ABSENT
PRESENT
126
1
121
5
39
8
<5days
5-10days
>10days


LENGTH OF POST OP STAY
POVIDONE IODINE
CHLORHEXIDINE
58
69
61
65
31
16
<5DAYS
5-10DAYS
>10DAYS

It was found that out of the total number 300 cases included in the study, 14 patients (4.7%) had been found to have the evidence of surgical site infection. 50% of these patients had an organism grown from the wound, while in the rest there was only macroscopic evidence of wound infection.

The rate of wound infection was looked at the two groups.

Table 11 shows 8% of those scrubbed with Povidone Iodine (12 patients out of 150) had surgical site infection(SSI), while in the Chlorhexidine group, it was 1.3% (2 out of 150 patients).

TABLE : 11

SCRUB	**SSI**		**P value**
	Absent	**Present**	
Povidone-iodine	138(92.0%)	12(8.0%)	0.103
Chlorhexidine	148(98.7%)	2(1.3%)	

FACTORS ASSOCIATED WITH SURGICAL SITE INFECTIONS:

The factors associated with surgical site infections were analyzed. The test variables were compared using Chi-square test for qualitative variables and student's test for quantitative variables. The variables for which the association was statistically significant ($p<0.05$) were introduced in a logistic model to explain the presence of surgical site infection(Tables 12-21).

Results of the univariate analysis showed site of surgery, duration of surgery, type of closure and length of post operative stay were significantly associated with surgical site infection. However logistic regression indicated that only factors significantly increased the chances of acquiring surgical site infection were duration of surgery, type of closure and length of post operative stay (Table 20,21,22).

The association of factors like age and sex of the patient, socio-economic status, co-morbid conditions like diabetes mellitus, systemic hypertension etc, personal habits like smoking and alcohol, ASA (American Society of Anaesthesia) grading, type of surgery with surgical site infected cases were statistically insignificant (Tables-12-19).

TABLE : 12

AGE	SSI		P value
	Absent	Present	
<10years	90(97.8%)	2(2.2%)	
10-30 years	17(100%)	0(0%)	0.275
30-50 years	78(95.1%)	4(4.9%)	
> 50 years	101(92.7%)	8(7.3%)	

TABLE : 13

SEX	SSI		P value
	Absent	Present	
MALE	202(95.3%)	10(4.7%)	0.949
FEMALE	84(95.5%)	4(4.5%)	

TABLE : 14

Socio-economic status	SSI		P value
	Absent	Present	
I	26(96.3%)	1(3.7%)	0.924
II	85(94.4%)	5(5.6%)	
III	141(95.3%)	7(4.7%)	
IV	34(97.1%)	1(2.9%)	
V	0	0	

TABLE : 15

SITE	SSI		P value
	Absent	Present	
Abdomen	48(87.3%)	7(12.7%)	0.120
Scrotum	20(100%)	0(0%)	
Groin	48(98.0%)	1(2.0%)	
Chest	92(93.9%)	6(6.1%)	
Perineum	14(100%)	0(0%)	
Limbs	23(100%)	0(0%)	
Back	2(100%)	0(0%)	
Breast	17(100%)	0(0%)	
Neck & Cheek	21(100%)	0(0%)	
Axilla	1(100%)	0(0%)	

TABLE : 16

CO-MORBIDITIES	SSI		P value
	Absent	Present	
YES	96(92.3%)	8(7.7%)	0.070
NO	190(96.9%)	6(3.1%)	

TABLE : 17

PERSONAL HABITS	SSI		P value
	Absent	Present	
NO	225(95.3%)	11(4.7%)	0.993
YES	61(95.3%)	3(4.7%)	

TABLE : 18

ASA-Grading	SSI		P value
	Absent	Present	
I	81(100%)	0(0%)	0.060
II	169(93.9%)	11(6.1%)	
III	36(92.3%)	3(7.7%)	

TABLE : 19

TYPE OF SURGERY	SSI		P value
	Absent	Present	
Clean cases	234(96.3%)	9(3.7%)	0.103
Clean-contaminated cases	52(91.2%)	5(8.8%)	

TABLE : 20

DURATION OF SURGERY	SSI		P value
	Absent	Present	
< 1 hr	56(100%)	0(0%)	<0.05
1 – 3 hrs	213(96.8%)	7(3.2%)	
> 3 hrs	17(70.8%)	7(29.2%)	

TABLE : 21

TYPE OF CLOSURE	SSI		P value
	Absent	Present	
Sutures	281(95.9%)	12(4.1%)	0.002
Staplers	5(71.4%)	2(28.6%)	

TABLE : 22

LENGTH OF POST-OP STAY	SSI		P value
	Absent	Present	
<5days	126(99.2%)	1(0.8%)	<0.05
5-10days	121(96.0%)	5(4.0%)	
>10days	39(83.0%)	8(17.0%)	

DISCUSSION

DISCUSSION:

This study presents a randomised clinical and microbiological profile of surgical site infected wounds and two groups of patients using two different antiseptic preparations have been compared.

As already discussed, surgical site infections increases mortality, morbidity and financial burden due to an increase in length of stay. Surgical site infection represent about one fifth of all health care associated infections and in the most meticulous review of literature the infection rate is always higher[(62)].

Preoperative disinfection of skin is one of the milestones for reducing surgical site infections and from 2010 Chlorhexidine-alcohol has been suggested to be superior to the classical Povidone Iodine disinfection. We, therefore, made an effort to study the role of Chlorhexidine scrub on surgical site infection at PSG Hospitals, Coimbatore.

The overall infection rate in the present study was 4.7% and compares favorably with other reported surgical site infection rates ranging from 2.5 to 41.9%[(65 to 72)]. Number of studies carried out in India indicate an overall infection rate of 4.04 to 30% for clean surgeries and 10.06 to 45% for clean contaminated

surgeries[66,68,71]. Findings in the present study showed that there is significant rise in infection rate with increased degree of operative contamination. The rate of infection for clean surgeries was3.7%, while in clean contaminated surgeries it was 8.8%.

The average baseline rate of surgical site infection at six participating hospitals was 14% with Povidone Iodine skin preparation. Our hypothesis was that substituting Chlorhexidine alcohol for Povidone Iodine would reduce the surgical site infection[74].

The infection rates observed in Chlorhexidine and Povidone Iodine in present study were 1.3% and 8.0% respectively. The difference in infection rates is statistically significant. It was concluded that Chlorhexidine is superior to Povidone Iodine in surgical site anti-sepsis.

In a prospective randomized clinical trial conducted between April 2004 and May 2008 at six university in united states, on a total of 809, the overall rate of surgical site infection was significantly lower in Chlorhexidine group than in the povidone iodine group(9.5% vs 16.1%, P value= 0.004). Chlorhexidine was significantly more protective than Povidone Iodine against both superficial and deep incisional infections[75].

A meta-analysis of clinical trials was conducted to determine whether preoperative antisepsis with Chlorhexidine or Povidone Iodine reduced surgical site infection in clean contaminated surgeries. It concluded that Chlorhexidine reduced postoperative surgical site infection when compared with Povidone Iodine (pooled odd ratio- 0.68,P=0.019)[76].

This study was conducted to determine if Chlorhexidine antiseptic scrub protocol reduces the rates of SSI's in elective surgeries compared with Povidone-Iodine antisepsis. Patients undergoing elective surgeries from the department of General and G.I Surgery, Cardiothoracic and vascular surgery and Pediatric surgery were treated with either Chlorhexidine or Povidone Iodine for pre-operative skin disinfection. The rate of surgical site infection as defined by the centers for disease control and prevention (CDC), and the risk factors for the occurrence of surgical site infections were calculated.

Antisepsis with Chlorhexidine was associated with a reduction in the overall rate of surgical site infections from (8.0) to (1.3%) when compared with Povidone Iodine protocol (P=0.103). The two groups of subjects were similar in regard to baseline characteristics and clinical history.

Apart from the Povidone Iodine, risk factors found to be associated with surgical site infections were duration of surgery, type of closure, length of post

operative stay. In a retrospective study, risk factors like systemic hypertension and Type 2 Diabetes Mellitus have been found[77]. However, they were found not to be statistically significant.

There was evidence from one study suggesting that pre-operative skin preparations with Chlorhexidine in methylated spirits led to a reduced risk of surgical site infections compared with an alcohol based Povidone Iodine solution[78].

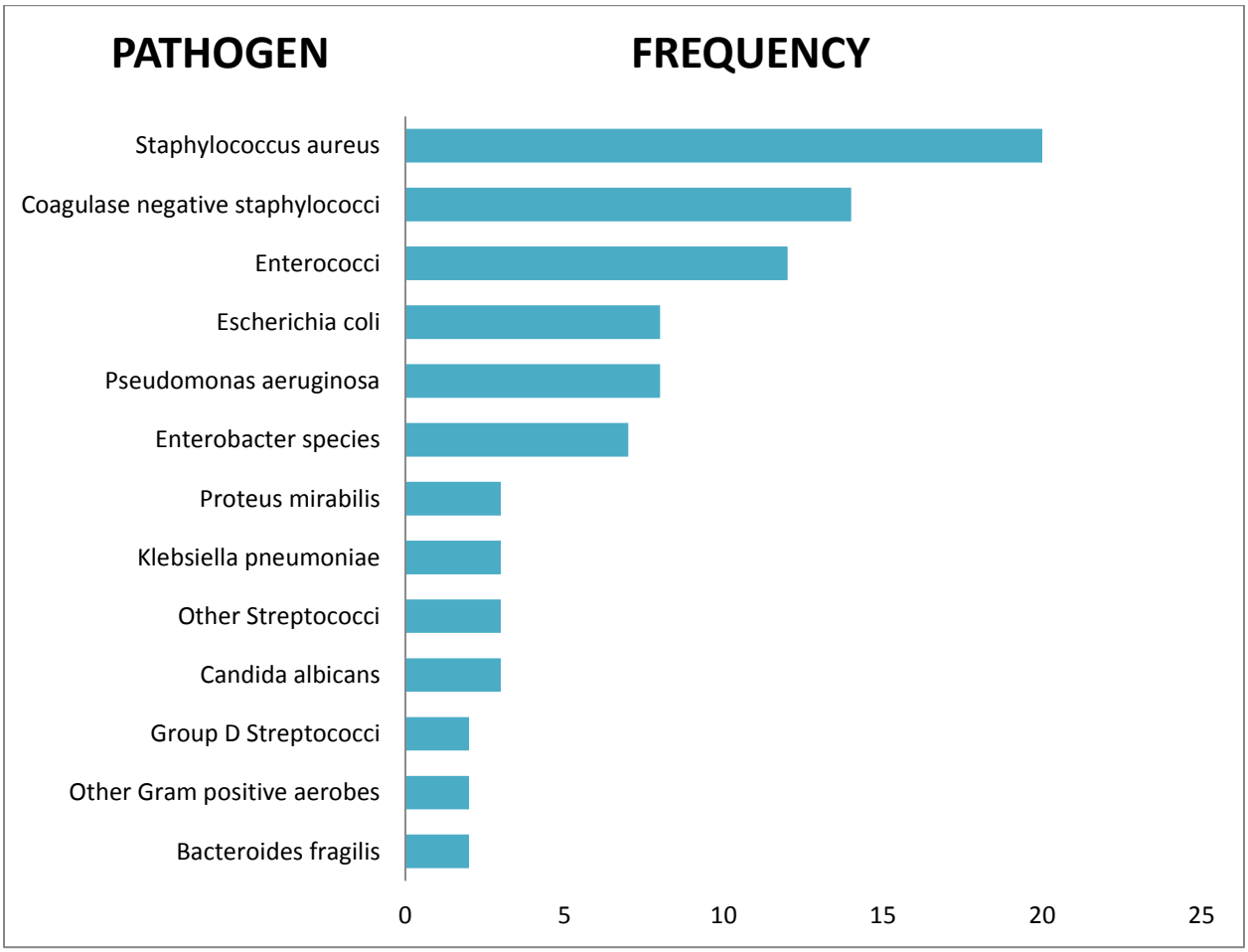
Nine randomized control trials were included in a meta-analysis which revealed that Chlorhexidine antisepsis was associated with significantly fewer surgical site infections and positive skin culture results than Iodine antisepsis[79]. In this randomized study the application of Chlorhexidine reduced the risk of surgical site infection by 1.3% as compared with the most common practice in the United states of using Povidone-Iodine which is 8.0% in this study.

Although both antiseptic preparations possess broad-spectrum antimicrobial activity, the superior clinical protection provided by Chlorhexidine is probably related to its more rapid action, persistent activity of despite exposure to bodily fluids and residual effects.

The superior clinical efficacy of Chlorhexidine in our study correlates well with previous microbiological studies showing that chlorhexidine based antiseptic

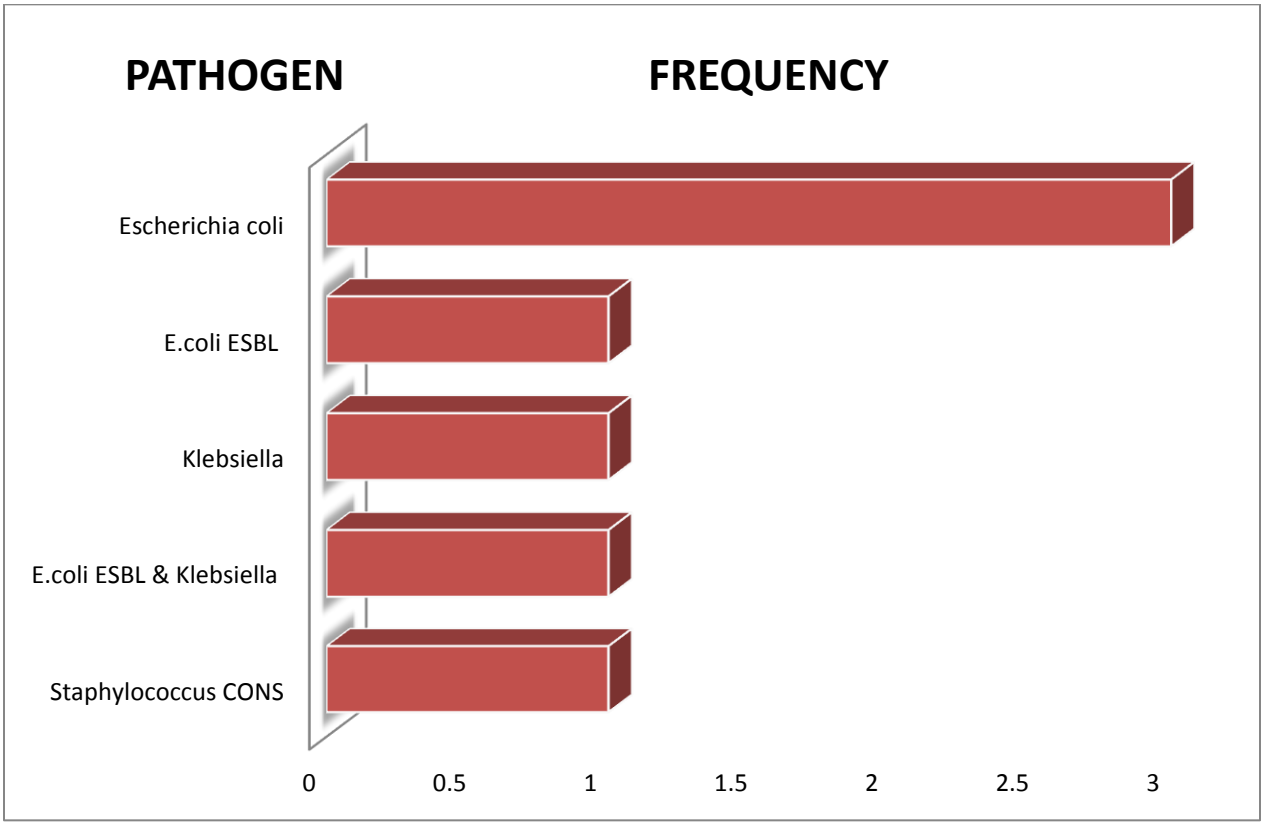
preparations are more effective than Povidone Iodine containing solutions in the operative field.

According to data from the NNIS system ,the distribution of pathogens isolated from surgical site infections has not changed markedly during the last decade. Staphylococcus Aureus[80,81,82], Coagulase negative Staphylococci, Enterococcus spp.,and Escherichia Coli remain the most frequently isolated pathogens[83,84]. Pathogens commomly associated with wound infections and frequency of occurrence.



In our study the overall surgical site infection was found in 14patients out of which 12 from Povidone Iodine group and 2 from the Chlorhexidine group. The microbiological examination for all surgical site infected patients revealed positive organism growth for 7patients out of 14 patients and the remaining had no organism growth.

The commonest organism found in this study was Escherichia coli and followed by Klebsiella pneumonia and Staphylococci species



Apart from the pre-operative skin antisepsis we also made an effort to analyse the risk factors involved in developing the surgical site infections. We found by multi-variate analysis, the factors which influence the surgical site infection were type of surgery, duration of surgery and length of post-operative stay .

In our study, length of postoperative stay had significance in developing surgical site infection. As it was already mentioned in a previous study, prolonged stay with exposure to hospital environment has been shown to increase the rate of surgical site infection[73]. Prolonged postoperative hospitalization, which is a major concern, has been evident in patients developing surgical site infection[68].

In the present study, duration of surgery had significance in developing surgical site infection. The other studies reported that it has been observed that wound infection rate is influenced by duration of operation[65,67-69,72]. With increase in duration of surgery the rate of infection increased in direct proportion. The results were found to be statistically significant.

CONCLUSION

CONCLUSION

- Chlorhexidine scrub as a preoperative skin preparation had less number of surgical site infections when compared to Povidone Iodine.

- Factors like duration of surgery, type of surgery and length of post operative stay had a significant impact in development of surgical site infections.

- Escherichia coli is the commonest isolate from the surgical site infected patients.

- Surgical site infections are still a real risk for surgery and represent a substantial burden of disease for both patients and health care services in terms of morbidity ,mortality and economically.

- Surveillance of Surgical site infections with feedback of appropriate data to surgeons would be desirable to reduce the Surgical site infection rates.

- Chlorhexidine is commercially available in aqueous or alcohol formulations and has broad activity against gram positive and negative bacteria, anerobes, yeast and some lipid enveloped viruses.

- Research has shown that surgical techniques, skin preparation and the timing, method of wound closure and length of hospital stay are significant factors that can influence of subsequent infection.

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MASTER SHEET

Key points (coding) of master sheet

Age:
- <10years – 0
- 10-30 years – 1
- 30-50 years – 2
- > 50 – 3

Sex:
- 0 – Male
- 1 – Female

SES: (socio economic status)
- 1 - Rs >3239
- 2 - Rs.1620-3239
- 3 - Rs.972 – 1620
- 4 – Rs.486 – 972
- 5 - Rs<486

DEPT(department)
- CTVS – Cardiothoracic and vascular surg
- PS – Paediatric Surgery
- S1-6 – General Surgery

BMI(Body mass Index)
- 0 - < 20
- 1 – 20-25
- 2 - > 25

SITE (of the surgery)
- 0 – Abdomen
- 1 – Scrotum
- 2 – Groin
- 3 – Chest
- 4 – Perineum
- 5 – Limbs
- 6 – Back
- 7 – Breast
- 8 – Neck & Cheek
- 9 – Axilla

CM - (Co moribidities)
- 0 – No Comornidities
- 1 – present

P.H- (Personal Habits) – Smoking and Alcohol h
- 0 – No
- 1 – Yes

Hb % - Hemoglobin level

TOA – Type of Anaesthesia
- GA – General Anaesthesia
- SA – Spinal Anaesthesia

EA – Epidural Anaesthesia

ASA – (American society of Anaesthesiology - grading1-6)

SCRUB – (Pre operative skin preparation)
1 – Povidone Iodine
2 – Chlorhexidine

DOS (Duration of surgery)
0 - < 1 hr
1 – 1 – 3 hrs
2 - > 3 hrs

TOC (Type of closure)
1 – Sutures
2 – Staplers

SSI (Surgical site infection)
0 – No evidence of SSI
1 – SSI present

LOPS (Length of postoperative stay)
0 - <5days
1 – 5-10days
2 - >10days

C/S : (Culture & sensitivity report)
0 - Sterile
1 – Escheriachia coli
2 – Klebsiella pneumonia
3 – Staphylococcus CONS

S.NO	IP NO	AGE	SEX	DEPT	BMI	SES	SITE	CM	P.H	HB%	TOA	ASA	SCRUB	TOS	DOS	TOC	SSI	LOPS	C/S
1	I14025632	3	0	CTVS	1	2	3	1	0	12	GA	2	1	2	0	0	0	1	
2	I14025995	3	0	CTVS	1	2	3	1	0	13	GA	2	2	1	1	0	0	2	
3	I14025600	3	0	CTVS	1	4	3	1	1	11	GA	2	1	1	1	0	0	1	
4	I14025890	3	0	CTVS	2	3	3	1	0	9.8	GA	2	1	1	1	0	0	1	
5	I14025765	3	0	CTVS	0	4	5	0	1	12	GA	2	2	1	1	0	0	2	
6	I14026380	2	1	CTVS	2	3	3	1	0	13	GA	2	2	1	1	0	0	1	
7	I14026713	3	0	CTVS	2	4	3	0	0	16	GA	2	2	1	2	0	0	2	
8	I14026460	2	1	CTVS	1	3	3	0	0	11	GA	2	1	1	1	0	0	2	
9	I14026664	2	1	CTVS	1	4	3	0	0	9.9	GA	2	1	1	1	0	0	1	
10	I14026361	2	0	CTVS	1	3	3	0	0	11	GA	2	1	1	1	0	0	1	
11	I14026975	3	0	CTVS	1	4	3	1	0	7.7	GA	2	2	1	1	0	0	2	
12	I14030051	3	0	CTVS	0	3	3	1	1	13	GA	2	1	1	1	0	0	1	
13	I14027676	3	0	CTVS	1	3	3	1	0	9.9	GA	3	1	1	1	0	0	1	
14	I14027230	2	0	CTVS	2	2	3	0	0	11	GA	2	1	1	1	0	1	1	3
15	I14027227	2	0	CTVS	1	3	3	0	0	12	GA	2	1	1	1	0	0	1	
16	I14027321	3	0	CTVS	0	4	3	1	1	6.9	GA	3	2	1	1	0	0	1	
17	I14028338	3	0	CTVS	1	2	3	0	0	10	GA	2	1	1	1	0	0	1	
18	I14028433	3	0	CTVS	1	4	3	0	1	13	GA	2	2	1	1	0	0	1	
19	I14027738	3	0	CTVS	2	4	3	1	0	7.4	GA	3	2	1	1	0	0	1	
20	I14027724	2	0	CTVS	2	3	3	1	0	13	GA	2	1	1	1	0	0	1	
21	I14028338	2	1	CTVS	2	3	3	1	0	12	GA	2	2	1	1	0	0	1	
22	I14028064	3	0	CTVS	2	4	3	1	1	16	GA	2	1	1	1	0	0	2	
23	I14028433	2	0	CTVS	1	4	3	0	1	16	GA	2	2	1	1	0	0	2	
24	I14027908	3	0	CTVS	2	4	3	0	0	15	GA	2	2	1	1	0	0	1	
25	I14028300	3	0	CTVS	2	3	3	1	0	12	GA	3	1	1	1	0	1	2	0
26	I14028745	3	0	CTVS	2	3	3	0	0	11	GA	2	1	1	1	0	0	1	
27	I14028668	3	0	CTVS	2	3	3	1	0	12	GA	2	1	1	1	0	0	1	
28	I14029001	2	0	CTVS	1	3	3	1	1	12	GA	3	1	1	2	0	1	1	1
29	I14029316	2	0	CTVS	1	3	3	0	0	15	GA	2	2	1	1	0	0	1	

30	I14028653	3	0	CTVS	1	3	3	1	0	15	GA	3	2	1	1	0	0	1	
31	I14029252	3	0	CTVS	2	3	3	1	0	14	GA	3	2	1	1	0	0	1	
32	I14029933	3	0	CTVS	1	4	3	0	1	13	GA	2	1	1	1	0	0	2	
33	I14030051	3	0	CTVS	1	3	3	1	1	13	GA	3	1	1	1	0	0	1	
34	I14030319	3	0	CTVS	2	4	3	1	0	14	GA	2	1	1	1	0	0	1	
35	I14030229	1	1	CTVS	0	3	3	0	0	14	GA	2	1	1	1	0	0	1	
36	I14030174	1	1	CTVS	0	3	3	0	0	13	GA	2	1	1	1	0	0	1	
37	I14030233	3	1	CTVS	2	3	3	1	0	12	GA	2	1	1	0	0	0	0	
38	I14030396	3	0	CTVS	2	3	3	1	1	14	GA	3	2	1	1	0	0	1	
39	I14030933	2	0	CTVS	2	3	3	0	1	17	GA	2	2	1	1	0	0	1	
40	I14031049	3	0	CTVS	1	2	3	1	1	11	GA	3	1	1	1	0	0	1	
41	I14031071	2	0	CTVS	2	4	3	0	0	12	GA	2	1	1	1	0	0	2	
42	I14031615	3	0	CTVS	2	3	3	0	0	12	GA	2	1	1	1	0	0	2	
43	I14031640	3	1	CTVS	2	3	3	1	1	11	GA	3	2	1	1	0	0	1	
44	I14032080	3	1	CTVS	1	1	3	0	0	12	GA	2	1	1	1	0	0	2	
45	I14031985	2	0	CTVS	0	4	3	0	1	11	GA	2	1	1	1	0	0	2	
46	I14031972	3	0	CTVS	1	3	3	1	0	9	GA	3	2	1	1	0	0	1	
47	I14032508	2	0	CTVS	1	1	5	0	1	17	GA	2	2	1	1	0	0	1	
48	I14032381	3	0	CTVS	0	2	3	0	0	9.5	GA	2	1	1	2	0	0	1	
49	I14032570	2	1	CTVS	1	1	3	0	0	13	GA	2	2	1	1	0	0	1	
50	I14032374	3	0	CTVS	0	2	3	1	1	15	GA	3	2	1	1	0	0	1	
51	I14032600	2	1	CTVS	0	2	3	1	0	12	GA	2	2	1	1	0	0	1	
52	I14033226	3	1	CTVS	1	2	3	1	0	11	GA	2	1	1	1	0	0	1	
53	I14033004	3	0	CTVS	1	2	3	0	0	13	GA	3	2	1	1	0	0	1	
54	I1403285	2	0	CTVS	2	3	3	1	0	12	GA	3	1	1	1	0	0	1	
55	I14032916	2	0	CTVS	1	3	5	0	1	11	GA	2	2	1	1	0	0	2	
56	I14032900	0	1	CTVS	0	2	3	0	0	13	GA	2	1	1	1	0	0	1	
57	I14033230	3	0	CTVS	1	2	3	0	0	13	GA	2	2	1	1	0	0	1	
58	I14033447	2	0	CTVS	1	3	3	1	0	16	GA	3	1	1	1	0	0	1	
59	I14032998	2	1	CTVS	2	2	3	0	0	13	GA	2	2	1	1	0	0	1	

60	I14033683	2	0	CTVS	1	2	3	1	1	13	GA	2	1	1	1	0	0	1	
61	I14033960	2	0	CTVS	1	3	3	1	0	11	GA	3	1	1	1	0	0	1	
62	I14033927	3	1	CTVS	2	3	3	1	0	14	GA	3	2	1	1	0	1	1	0
63	I14034057	3	0	CTVS	1	2	3	0	0	15	GA	2	2	1	1	0	0	1	
64	I14033833	3	0	CTVS	1	3	3	1	1	14	GA	3	2	1	1	0	0	1	
65	I14033841	3	0	CTVS	1	2	3	1	0	12	GA	2	2	1	1	0	0	1	
66	I14034243	3	1	CTVS	2	3	3	1	0	12	GA	2	1	1	1	0	0	1	
67	I14034340	3	0	CTVS	2	3	3	0	1	15	GA	2	2	1	1	0	0	1	
68	I14034751	3	0	CTVS	1	4	3	1	1	12	GA	2	1	1	1	0	0	1	
69	I14034880	2	0	CTVS	1	4	3	0	1	10	GA	2	2	1	1	0	0	1	
70	I14034972	2	0	CTVS	1	3	3	0	1	15	GA	2	1	1	1	0	0	1	
71	I14034533	3	0	CTVS	2	3	3	0	1	12	GA	2	1	1	1	0	0	1	
72	I14035233	3	1	CTVS	2	3	3	1	0	11	GA	3	1	1	1	0	0	1	
73	I14035151	3	1	CTVS	1	3	5	1	0	15	GA	2	2	1	1	0	0	1	
74	I14034747	3	0	CTVS	2	2	3	1	0	13	GA	3	1	1	2	0	0	2	
75	I14035150	3	0	CTVS	0	4	3	0	1	9.9	GA	3	2	1	1	0	0	1	
76	I14034537	3	0	CTVS	2	3	3	0	0	14	GA	2	2	1	2	0	0	2	
77	14035358	3	0	CTVS	1	3	5	1	1	12	GA	3	2	2	1	0	0	1	
78	I14035119	3	0	CTVS	1	2	3	0	1	15	GA	2	1	1	1	0	0	1	
79	I14032589	3	0	CTVS	1	3	3	1	0	14	GA	2	2	1	1	0	0	2	
80	I14035920	3	0	CTVS	2	3	3	1	1	15	GA	3	1	1	1	0	0	2	
81	14036128	3	0	CTVS	2	3	3	1	1	13	GA	3	1	1	2	0	0	2	
82	I14036579	3	0	CTVS	1	1	3	1	1	13	GA	3	2	1	1	0	0	2	
83	I14036227	3	0	CTVS	2	4	3	0	1	13	GA	3	1	1	2	0	0	1	
84	I14036584	3	0	CTVS	1	3	5	1	1	11	GA	3	2	1	1	0	0	1	
85	I14036783	3	0	CTVS	1	2	3	1	1	14	GA	2	2	1	1	0	0	1	
86	I14035652	3	0	CTVS	2	3	3	1	1	14	GA	3	2	1	2	0	0	0	
87	I14036761	3	0	CTVS	1	2	3	0	1	16	GA	2	2	1	1	0	0	1	
88	I14036917	3	0	CTVS	1	3	3	1	1	15	GA	3	2	1	1	0	0	1	
89	I14036714	3	0	CTVS	1	3	3	1	1	12	GA	3	2	1	1	0	0	1	

90	I14037037	2	0	CTVS	2	3	3	1	1	14	GA	3	2	1	1	0	0	1	
91	I14037433	2	1	CTVS	0	2	3	1	0	9.7	GA	3	1	1	1	0	0	1	
92	I14037093	3	0	CTVS	1	3	3	0	1	14	GA	3	2	1	1	0	0	2	
93	I15000145	3	1	CTVS	1	2	3	1	0	9.8	GA	2	1	1	1	0	0	1	
94	I14037480	3	1	CTVS	1	3	3	1	0	12	GA	3	2	1	1	0	0	1	
95	I14037679	3	0	CTVS	1	2	3	1	1	15	GA	3	2	1	1	0	0	1	
96	I15000541	3	0	CTVS	1	2	3	1	0	14	GA	2	1	1	1	0	1	1	0
97	I15000457	2	1	CTVS	0	2	3	1	0	13	GA	2	2	1	1	0	0	1	
98	I14037687	3	0	CTVS	1	3	5	1	0	15	GA	2	1	1	1	0	0	2	
99	I14037680	2	0	CTVS	1	3	3	1	0	11	GA	2	2	1	1	0	0	1	
100	I15000584	2	1	CTVS	1	2	3	0	0	14	GA	2	1	1	1	0	0	1	
101	I14024772	0	0	PS-3	7	3	4	0	0	12	GA	1	1	2	2	0	0	2	
102	I14024778	0	0	PS-3	8	2	1	0	0	11	GA	1	2	1	0	0	0	0	
103	I14024961	0	0	PS-3	4	1	0	0	0	15	GA	2	2	2	0	0	0	0	
104	I14025135	0	0	PS-2	11	2	2	0	0	13	GA	1	1	1	0	0	0	1	
105	I14025850	1	0	PS-3	38	2	2	0	0	14	GA	2	2	1	0	0	0	0	
106	I14025939	0	1	PS-3	9.3	3	3	0	0	13	GA	2	1	1	0	0	0	0	
107	I14025880	0	0	PS-3	8.1	3	1	0	0	12	GA	1	2	1	0	0	0	0	
108	I14025958	0	1	PS-3	8.7	3	4	1	0	13	GA	2	1	2	2	0	0	1	
109	I14026034	0	0	PS-3	11	3	2	0	0	12	GA	2	2	1	1	0	0	0	
110	I14026366	0	0	PS-3	15	2	4	0	0	10	GA	2	1	2	2	0	0	2	
111	I14026511	0	0	PS-2	21	1	5	0	0	12	GA	2	2	1	0	0	0	0	
112	I14026560	0	0	PS-3	24	3	4	0	0	12	GA	1	2	2	1	0	0	1	
113	I14026559	0	0	PS-3	12	3	0	0	0	14	GA	2	2	2	1	0	0	1	
114	I14026859	0	0	PS-3	14	3	2	0	0	14	GA	2	2	1	0	0	0	0	
115	I14026860	0	0	PS-3	8.7	4	1	0	0	10	GA	2	2	1	0	0	0	0	
116	I14026862	0	0	PS-2	19	1	2	0	0	13	GA	2	2	1	0	0	0	0	
117	I14026601	0	0	PS-3	4.3	3	0	0	0	10	GA	2	1	2	1	0	0	2	
118	I14027218	0	0	PS-3	4.3	3	6	0	0	11	GA	2	1	1	1	0	0	1	
119	I14027333	0	0	PS-2	15	2	5	0	0	12	GA	2	2	1	0	0	0	0	

120	I14027632	0	0	PS-3	15	1	1	0	0	13	GA	2	2	1	0	0	0	0	
121	I14027094	0	0	PS-3	11	4	0	0	0	11	GA	1	2	2	1	0	0	1	
122	I14027692	0	0	PS-3	19	3	1	0	0	9.5	GA	2	2	1	0	0	0	0	
123	I14027840	0	0	PS-3	3.6	2	2	0	0	11	GA	2	1	1	1	0	0	0	
124	I14028830	0	0	PS-1	8.9	3	2	0	0	11	GA	1	1	1	1	0	0	0	
125	I14029126	0	0	PS-3	5.3	3	0	0	0	8.6	GA	2	1	2	0	0	0	0	
126	I14029332	1	0	PS-3	27	2	2	0	0	12	GA	2	2	1	0	0	0	0	
127	I14029347	0	0	PS-1	8	2	1	0	0	9.7	GA	2	2	1	0	0	0	0	
128	I14029355	0	1	PS-3	7.6	3	2	0	0	11	GA	2	2	1	0	0	0	0	
129	I14029455	0	0	PS-2	2.7	3	3	1	0	17	GA	2	1	2	1	0	1	2	0
130	I14029430	0	1	PS-3	3.9	4	3	0	0	11	GA	2	2	1	1	0	0	1	
131	I14029438	0	0	PS-1	6.6	3	0	0	0	9.8	GA	2	2	2	1	0	0	1	
132	I14029844	0	0	PS-3	30	3	2	0	0	12	GA	2	1	1	1	0	0	0	
133	I14029874	0	0	PS-3	10	2	1	0	0	13	GA	1	2	1	0	0	0	0	
134	I14030103	1	0	PS-1	29	3	2	1	0	13	GA	2	2	1	0	0	0	0	
135	I14030625	0	0	PS-3	2.4	3	3	1	0	14	GA	3	2	2	1	0	0	2	
136	I14030721	0	0	PS-3	12	2	4	0	0	11	GA	2	1	2	1	0	0	1	
137	I14030902	0	0	PS-3	6.7	3	3	0	0	11	GA	2	2	1	0	0	0	0	
138	I14030580	0	0	PS-1	11	3	0	0	0	12	GA	2	1	2	2	0	1	2	0
139	I14030719	0	0	PS-3	18	3	4	0	0	13	GA	2	2	1	1	0	0	0	
140	I14031643	0	0	PS-3	8.9	3	0	0	0	11	GA	2	2	2	1	0	0	0	
141	I14031388	0	1	PS-3	5.9	2	0	0	0	11	GA	2	1	2	1	0	0	0	
142	I14031563	0	1	PS-3	8	3	0	0	0	12	GA	2	1	2	2	0	0	1	
143	I14031797	0	0	PS-1	12	4	0	0	0	10	GA	2	1	2	2	0	0	2	
144	I14031449	0	1	PS-3	13	3	0	0	0	13	GA	2	2	2	1	0	0	1	
145	I14032316	1	0	PS-3	51	1	1	0	0	15	GA	2	2	2	1	0	0	2	
146	I14033019	0	0	PS-3	9.6	3	1	0	0	12	GA	2	1	1	1	0	0	0	
147	I14033526	0	0	PS-2	12	2	1	0	0	8.8	GA	1	2	1	0	0	0	0	
148	I14034261	0	0	PS-3	11	1	4	0	0	12	GA	2	1	2	1	0	0	0	
149	I14033238	0	0	PS-3	15	2	1	0	0	12	GA	1	2	1	1	0	0	0	

150	I14033716	0	0	PS-3	3	3	2	0	0	15	GA	1	2	1	0	0	0	0	
151	I14033978	0	1	PS-3	4.9	3	0	0	0	13	GA	2	2	1	2	0	0	1	
152	I14034536	0	0	PS-2	3.9	3	0	0	0	11	GA	2	1	2	1	0	0	1	
153	I14034881	0	0	PS-3	13	2	0	0	0	11	GA	2	1	2	1	0	0	2	
154	I14035173	0	0	PS-3	9.5	3	1	0	0	11	GA	1	2	2	0	0	0	0	
155	I14035148	0	0	PS-1	15	4	4	0	0	11	GA	2	1	2	1	0	0	0	
156	I14035338	0	1	PS-3	17	3	0	0	0	9.2	GA	1	1	2	1	0	0	0	
157	I14035330	0	0	PS-3	8.8	1	1	0	0	9.9	GA	1	2	1	0	0	0	0	
158	I14035575	0	1	PS-1	8.5	3	0	0	0	9.8	GA	1	1	2	1	0	0	1	
159	I14035988	0	0	PS-3	5.6	3	0	0	0	11	GA	2	2	2	1	0	0	0	
160	I14035972	0	1	PS-2	3.5	2	0	0	0	10	GA	2	1	2	1	0	0	0	
161	I14035993	0	0	PS-3	15	3	2	0	0	12	GA	1	2	1	0	0	0	0	
162	I14036366	0	0	PS-3	2.9	3	0	0	0	13	GA	2	2	1	1	0	0	0	
163	I14036333	0	0	PS-2	4.4	3	0	0	0	9.7	GA	2	1	2	1	0	0	1	
164	I14037072	1	1	PS-1	36	2	4	0	0	14	GA	2	1	2	1	0	0	0	
165	I14037178	0	0	PS-2	7.8	3	0	0	0	11	GA	2	1	2	1	0	0	0	
166	I14037110	1	0	PS-1	24	1	1	0	0	11	GA	1	1	1	0	0	0	0	
167	II14037494	0	0	PS-1	10	3	2	0	0	11	GA	1	1	1	0	0	0	0	
168	I14037569	0	0	PS-2	22	3	0	0	0	14	GA	2	1	1	1	0	0	0	
169	I15000042	0	0	PS-2	15	2	4	0	0	13	GA	1	1	1	0	0	0	0	
170	I15000766	0	0	PS-3	11	3	4	0	0	12	GA	1	1	2	1	0	0	1	
171	I15000750	0	0	PS-3	8	2	5	0	0	12	GA	1	1	1	1	0	0	1	
172	I15000833	1	0	PS-3	29	1	5	0	0	12	GA	1	1	1	1	0	0	0	
173	I15001009	0	0	PS-3	8.3	1	1	0	0	12	GA	1	2	1	1	0	0	0	
174	I15001237	1	1	PS-2	39	2	7	0	0	13	GA	2	2	1	1	0	0	0	
175	I14037233	0	0	PS-3	5.2	3	0	0	0	9.6	GA	2	1	2	1	0	0	2	
176	I15001549	0	0	PS-3	12	3	4	0	0	12	GA	2	2	2	1	0	0	1	
177	I15001608	0	1	PS-3	4.3	2	2	0	0	11	GA	2	2	1	1	0	0	0	
178	I15001536	0	0	PS-3	4.6	3	0	0	0	10	GA	2	2	2	1	0	0	0	
179	I15001543	0	0	PS-3	7.4	2	0	0	0	12	GA	2	1	2	1	0	0	1	

180	I15002112	0	0	PS-3	5.5	2	1	0	0	9.6	GA	2	2	1	1	0	0	0	
181	I15001935	0	0	PS-3	9.6	1	0	0	0	11	GA	2	2	2	1	0	0	0	
182	I15002698	0	0	PS-1	7.8	2	4	0	0	11	GA	2	2	2	1	0	0	1	
183	I15002925	0	0	PS-2	8.8	3	0	0	0	11	GA	1	2	2	1	0	0	1	
184	I15003331	0	0	PS-2	18	2	2	0	0	13	GA	1	2	1	0	0	0	0	
185	I15003753	0	0	PS-3	4	1	2	0	0	8.9	GA	1	1	1	0	0	0	0	
186	I15004353	0	0	PS-3	4.9	3	0	0	0	10	GA	2	1	2	1	0	0	1	
187	I15004549	0	0	PS-3	15	2	1	0	0	11	GA	2	2	1	0	0	0	0	
188	I15004968	0	0	PS-3	8.1	2	2	0	0	16	GA	1	1	1	0	0	0	0	
189	I15005212	0	0	PS-3	3	3	2	0	0	20	GA	2	2	1	1	0	0	0	
190	I15005892	0	0	PS-3	2.2	3	2	0	0	9.2	GA	2	1	1	1	0	0	0	
191	I15006108	0	0	PS-2	5.9	2	0	0	0	14	GA	2	1	2	1	0	0	0	
192	I15006325	0	0	PS-2	19	1	4	0	0	12	GA	1	1	2	1	0	0	1	
193	I15006796	1	0	PS-2	39	2	1	0	0	15	GA	1	1	1	1	0	0	0	
194	I15007021	0	1	PS-2	7.7	3	6	0	0	12	GA	1	1	1	1	0	0	0	
195	I15006622	0	0	PS-3	18	2	8	0	0	13	GA	1	1	1	0	0	0	0	
196	I15007154	0	0	PS-1	3.4	1	2	0	0	11	GA	2	1	1	0	0	0	0	
197	I15007411	0	0	PS-3	12	3	0	0	0	12	GA	1	2	2	1	0	0	1	
198	I15007581	0	0	PS-2	7.5	3	0	0	0	11	GA	2	1	2	1	0	0	1	
199	I15007611	0	0	PS-1	3.9	2	0	0	0	16	GA	2	1	2	1	0	0	1	
200	I15008015	0	0	PS-3	10	2	9	0	0	11	GA	1	1	1	0	0	0	0	
201	I14030178	3	0	S1	1	3	2	1	0	12	SA	2	1	1	1	0	0	0	
202	I14030200	3	1	S1	1	2	8	0	0	11	GA	1	2	1	1	0	0	0	
203	I14030326	2	1	S2	1	3	8	0	0	13	GA	1	1	1	1	0	0	0	
204	I14030388	2	1	S1	1	2	8	1	0	13	GA	2	2	1	1	0	0	0	
205	I14030382	2	0	S4	1	3	0	0	1	13	GA	2	1	2	2	1	1	2	1
206	I14031237	3	0	S6	1	2	0	0	0	14	SA	1	2	1	1	0	0	1	
207	I14032081	2	1	S6	1	2	5	1	0	12	RA	3	1	1	0	0	0	0	
208	I14030828	3	1	S6	2	1	7	0	0	12	GA	2	2	1	1	1	0	1	
209	I14030828	3	1	S6	2	3	7	0	0	12	GA	2	2	1	1	1	0	2	

210	I14031607	3	1	S6	1	4	0	1	0	12	SA	2	2	1	0	0	0	0	
211	I14031624	2	0	S6	1	1	0	0	0	15	SA	2	2	1	0	0	0	1	
212	I14032098	1	0	S6	2	3	0	0	0	15	GA	2	1	2	2	0	0	2	
213	I14031927	2	1	S5	2	2	2	0	0	12	GA	1	2	1	1	0	0	1	
214	I14033412	2	0	S3	2	3	2	0	0	14	SA	1	1	1	1	0	0	1	
215	I14033440	2	0	S6	1	1	5	1	1	15	SA	2	2	1	1	0	0	0	
216	I14033655	2	1	S2	1	3	7	0	0	9.2	GA	1	1	1	0	0	0	0	
217	I14033412	2	0	S3	1	2	2	0	1	14	SA	1	2	1	1	0	0	1	
218	I14036722	3	0	S6	2	3	2	0	1	15	SA	2	1	1	0	0	0	0	
219	I14033412	2	0	S3	1	2	2	0	0	14	SA	1	2	1	1	0	0	0	
220	I14034027	3	0	S5	1	1	2	1	1	11	SA	2	2	1	0	0	0	1	
221	I14033599	3	1	S6	1	4	0	0	0	10	GA	2	1	2	2	0	1	2	1
222	I14034312	3	0	S1	2	2	2	0	1	15	SA	1	2	1	1	0	0	0	
223	I14034826	2	0	S4	2	3	2	0	1	13	SA	1	2	1	1	1	0	0	
224	I14034780	3	0	S4	1	4	2	1	1	12	SA	2	2	1	1	1	0	0	
225	I14035141	2	1	S5	1	2	7	1	0	12	GA	2	1	1	0	0	0	0	
226	I14035144	2	1	S1	1	3	2	1	0	13	GA	2	2	1	1	0	0	0	
227	I14035149	2	1	S1	1	2	8	1	0	12	GA	2	1	1	1	0	0	0	
228	I14035096	2	0	S4	1	3	0	0	0	16	SA	1	2	1	1	0	0	0	
229	I14035176	2	0	S5	1	4	5	0	1	16	SA	1	1	1	1	0	0	1	
230	I14034846	2	0	S5	1	2	2	1	0	17	SA/EA	2	2	1	1	0	0	1	
231	I14034517	3	0	S5	1	3	2	1	1	13	SA	2	1	1	1	0	0	1	
232	I14035428	2	0	S6	1	1	0	0	1	16	GA	2	2	2	2	1	1	2	0
233	I14036438	3	0	S6	2	2	2	1	0	16	SA	2	1	1	1	0	1	0	0
234	I14035091	3	0	S4	2	2	2	1	1	9.8	SA	2	1	1	1	0	0	0	
235	I14036438	3	0	S4	2	3	2	1	0	12	SA	2	2	1	1	1	0	1	
236	I14036597	1	1	S6	1	1	8	0	0	11	GA	2	2	1	1	0	0	0	
237	I14035760	3	0	S6	1	3	8	0	1	12	LA	1	2	1	0	0	0	1	
238	I14037085	3	0	S2	2	3	5	1	1	12	GA	2	2	1	0	0	0	0	
239	I14036967	2	1	S2	2	3	8	0	0	12	GA	1	1	1	1	0	0	0	

240	I14037164	2	1	S5	1	3	7	0	0	13	GA	1	1	1	1	0	0	0	
241	I14037573	3	0	S2	2	3	2	0	1	12	SA	1	2	1	1	0	0	1	
242	I15000408	2	1	S5	1	3	7	0	0	11	GA	1	1	1	1	0	0	0	
243	I15000870	3	1	S5	1	2	7	1	0	12	GA	2	1	1	0	0	0	0	
244	I15001682	2	1	S4	1	2	8	0	0	12	GA	1	2	1	1	0	0	0	
245	I15000901	1	0	S1	1	2	2	0	0	15	SA	1	1	1	1	0	0	1	
246	I15001755	3	0	S2	1	4	2	0	1	15	SA	1	1	1	0	0	0	0	
247	I15001908	2	0	S2	1	2	0	1	1	14	SA	2	1	1	1	0	0	0	
248	I15002022	2	0	S6	1	2	5	0	0	15	GA	1	2	1	0	0	0	0	
249	I15002099	2	0	S2	1	3	5	0	0	15	SA	1	1	1	1	0	0	0	
250	I15002211	2	1	S5	2	3	5	0	0	12	GA	1	1	1	0	0	0	0	
251	I15002969	3	1	S5	1	3	5	0	0	12	SA	1	1	1	1	0	0	0	
252	I15003026	2	1	S5	0	3	2	0	0	12	SA	1	2	1	1	0	0	1	
253	I15004183	2	1	S5	0	1	7	0	0	12	GA	1	1	1	0	0	0	0	
254	I15004307	3	1	S3	2	2	0	1	0	11	SA	2	1	1	1	0	1	2	2
255	I15004635	2	1	S6	2	3	8	0	0	14	GA	1	2	1	1	0	0	0	
256	I15005534	2	1	S5	1	2	0	0	0	13	SA/EA	1	1	1	1	0	0	2	
257	I15009454	2	0	S4	1	4	8	1	0	12	GA	2	2	1	1	0	0	0	
258	I15006085	3	0	S5	1	2	2	1	1	14	SA	2	1	1	1	0	0	1	
259	I15005239	2	0	S5	1	3	5	0	0	14	SA	1	1	1	1	0	0	2	
260	I15005707	2	1	S6	1	3	0	1	0	12	GA	2	2	2	1	0	0	1	
261	I15004790	2	1	S6	2	3	5	0	0	12	SA	1	2	1	0	0	0	1	
262	I15005346	2	0	S5	1	3	2	0	1	16	SA	2	1	1	1	0	0	1	
263	I15006097	2	1	S4	1	3	0	1	0	12	GA	2	2	2	2	0	0	2	
264	I15005926	3	0	S4	2	2	2	1	0	12	SA	2	2	1	1	0	0	0	
265	I15005550	2	0	S4	1	3	5	0	0	15	SA	1	1	1	1	0	0	0	
266	I15005345	2	1	S6	1	3	8	0	0	8.6	GA	1	2	1	1	0	0	0	
267	I15006133	3	0	S2	2	3	0	0	0	14	SA	2	1	1	2	0	1	2	1&2
268	I15007118	3	1	S4	0	4	0	0	0	13	GA	1	1	2	2	0	0	2	
269	I15006977	3	0	S5	1	3	0	1	1	14	SA	2	1	1	1	0	0	1	

270	I15007403	3	1	S3	2	2	7	1	0	12	GA	2	1	1	1	0	0	2	
271	I15007669	3	0	S5	1	2	2	1	0	12	SA	3	2	1	1	0	0	0	
272	I15007441	2	1	S3	1	3	8	1	0	13	GA	2	1	1	1	0	0	1	
273	I15007562	3	0	S4	1	2	0	0	0	5.8	GA	1	1	2	1	0	0	2	
274	I15007955	3	0	S4	1	3	8	1	0	13	GA	2	1	1	1	0	0	0	
275	I15007518	2	0	S4	0	3	2	0	0	17	SA	1	2	1	1	0	0	0	
276	I15008263	1	0	S4	0	3	1	0	0	15	SA	1	1	1	1	0	0	0	
277	I15007764	2	0	S4	1	4	0	0	0	7.2	GA	1	2	2	2	0	0	2	
278	I15008716	3	1	S4	1	3	8	1	0	12	GA	2	2	1	1	0	0	0	
279	I15009028	1	1	S4	1	3	8	0	0	12	GA	1	1	1	1	0	0	0	
280	I15008558	2	1	S6	1	3	8	0	0	13	GA	1	1	1	1	0	0	0	
281	I15009155	2	0	S4	1	2	0	1	0	13	SA	2	2	1	1	0	0	0	
282	I15009454	2	0	S4	1	4	8	1	0	12	GA	2	2	1	1	0	0	0	
283	I15009244	3	1	S4	1	3	7	0	0	12	GA	1	2	1	1	0	0	0	
284	I15009420	3	1	S4	2	2	0	1	0	14	SA+EA	2	1	1	2	0	1	1	1
285	I15009193	3	1	S5	1	3	2	1	1	11	SA	2	2	1	1	0	0	1	
286	I15009182	2	1	S2	1	4	8	0	0	12	GA	1	1	1	1	0	0	2	
287	I15009609	2	1	S6	1	2	8	0	0	12	GA	1	2	1	1	0	0	0	
288	I15009669	3	0	S2	1	3	8	1	0	11	GA	2	1	1	1	0	0	0	
289	I15009826	3	1	S4	1	2	7	1	0	12	GA	2	2	1	1	0	0	0	
290	I15009866	3	0	S4	1	4	2	1	1	16	SA	2	2	1	1	0	0	0	
291	I15009953	3	1	S6	1	2	7	0	0	11	GA	1	1	1	0	0	0	0	
292	I15009731	2	0	S4	1	1	1	0	0	13	SA	1	2	1	1	0	0	0	
293	I15010128	1	1	S4	1	2	7	0	0	14	GA	1	1	1	0	0	0	0	
294	I15010105	2	1	S4	2	3	7	0	0	12	GA	1	2	1	0	0	0	0	
295	I15010091	3	0	S1	1	3	2	0	1	12	SA	1	2	1	1	0	0	0	
296	I15010268	3	1	S1	1	2	7	1	0	11	GA	2	1	1	0	0	0	0	
297	I15010221	2	1	S2	2	3	0	1	0	11	SA	2	2	1	1	0	0	1	
298	I15010208	3	1	S4	1	2	5	0	0	11	SA	1	1	1	1	0	0	0	
299	I15010391	2	1	S4	1	1	7	1	0	12	GA	2	1	1	1	0	0	0	

300	I15010637	2	1	S6	2	3	0	1	0	12	GA	2	2	1	1	0	0	0	